OPERATION AND SERVICE MANUAL

for 1974

MODEL 4301A RF UNIT HOLDER

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GAITHERSBURG, MARYLAND

OPERATION AND SERVICE MANUAL

for 1974

MODEL 4301A RF UNIT HOLDER

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Weinschel Engineering
Gaithersburg, Maryland
1974

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ADDENDUM
FOR OPERATING AND SERVICE MANUALS
MODELS 430A, 4310A/K, 4301, 4302, and RF UNITS

CAUTION

Ensure that the fan on the rear of the Model 430A Mainframe is installed and operational when an RF Unit is used. Otherwise, serious damage may occur within the unit.

When a Model 4302 Manual Control Unit is installed in a Model 430A Mainframe, the fan on the rear of the 430A must be removed. The removal of the fan is necessary to gain access to the connectors and terminal board on the rear panel of the 4302.

To remove the fan, proceed with the following steps:

a. Turn off power to the unit.

b. Disconnect fan plug (P14). Accessible either by removing the top cover or removing the plug-in unit.

c. Remove trim on left rear of unit (secured by two Phillips screws) and slide filler strips from side of unit.

d. Remove the two screws and two bolts securing the fan to the unit. Remove fan and retain for future use.

e. Replace, bolts, screws, filler strips and trim.

CAUTION

The fan is not required when a Model 4302 is installed in the mainframe. However, when an RF Unit is installed, the fan must be connected or serious damage to the unit may result.

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a. Turn off power to the unit.

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c. Remove trim on left rear of unit (secured by two Phillips screws) and slide filler strips from side of unit.

d. Remove the two screws and two bolts securing the fan to the unit. Remove fan and retain for future use.

e. Replace, bolts, screws, filler strips and trim.

CAUTION

The fan is not required when a Model 4302 is installed in the mainframe. However, when an RF Unit is installed, the fan must be connected or serious damage to the unit may result.

SECTION 1

GENERAL INFORMATION

1.1 SCOPE OF MANUAL

This manual contains information necessary for understanding the application and operation of the Model 4301A RF Unit Holder used with the Model 430A Sweep Oscillator. The manual provides a general description, installation information, operating instructions, principles of operation and maintenance information. A complete set of schematic diagrams is also provided to aid in understanding the various modes of operation and for proper servicing of the equipment.

1.2 DESCRIPTION

The Model 4301A RF Unit Holder accepts one or two RF Units. With the Model 430A Mainframe and a Model 4302A Manual Control Unit, either of the two RF Units plugged into the Model 4301A can be selected for operation. If additional Model 4301A's are cascaded with their associated RF Units, up to six different RF Units can be selected for operation. Figure 1-1 shows a Model 4301A RF Unit Holder with two RF Units in place together with a Model 430A Sweep Oscillator and Model 4302A Manual Control Unit.

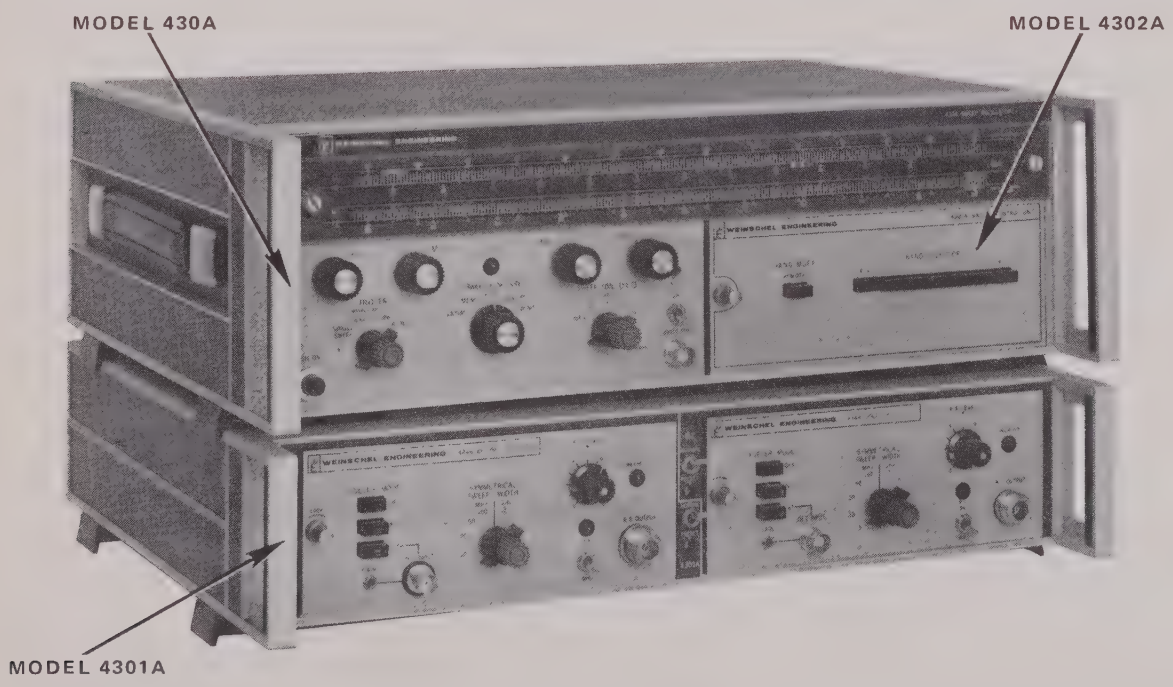


Figure 1-1. Model 4301A Unit Holder (RF Units Installed), Used With Model 430A Sweep Oscillator

Table 1-1. Specifications

FREQUENCY RANGE:	Determined by RF Units.
SWEEP FUNCTIONS:	Determined by Sweep Oscillator.
PRESET FUNCTIONS:	CW and symmetrical sweep center frequency may be preset or may be determined by sweep oscillator.
AMBIENT TEMPERATURE:	0^{o} to $+50^{o}$C operating -55^{o} to $+85^{o}$C storage
POWER:	Supplies by sweep oscillator.
DIMENSIONS:	3-7/8 in. (9.8 cm.) H x 16-3/4 in. (42.5 cm.) W x 13-3/4 in. (34.9 cm.) D
WEIGHT:	9 lbs. (4.1 kg.) excluding RF Units.

SECTION 2

INSTALLATION

2.1 UNPACKING

The Weinschel Engineering Model 4301A RF Unit Holder is shipped in a double carton with two inches of packing material between the inner and outer cartons. Use normal care when unpacking the instrument and removing the packing material. Do not destroy the cartons or packing material until the equipment is thoroughly inspected. If damage is found, notify the carrier immediately and do not destroy any packing material until an agent of the carrier has examined it. Under U. S. shipping regulations, damage claims must be collected by the consignee; do not return the instrument to Weinschel Engineering until a claim for damages has been established.

2.2 INSTALLATION

Two rear panel cable assemblies are supplied for interconnection with the Model 430A Mainframe. Figure 2-1 illustrates how these connections are to be made.

A multiconductor interconnecting cable with a 36-pin connector on each end is referenced as IC#1 in Figure 2-1. These connections, as well as the following ones, should be made with the AC power turned OFF. The second cable with two multi-pin connectors at one end and a single connector at the other end is referenced as IC#2.

The selected RF Units should be plugged into the front panel openings. The AC power can now be turned on and the equipment is ready for use.

2.3 OPERATING TEMPERATURE RANGE

The Model 4301A is designed to operate within its specifications when the ambient temperature is between 0^{o}C and $+50^{o}$C. Operating in ambient temperatures beyond these limits could affect the accuracy of the instrument and cause damage to its circuits.

2.4 RACK/BENCH CONVERSION

The Model 4301A is shipped as a bench-type instrument. For bench use the unit is conveniently raised on its four plastic feet.

To prepare the unit for rack mounting, remove the feet and tilt-stand, install rack adaptors and filler strip as illustrated in Figure 2-2. Rack adaptors and a filler strip are supplied as an Accessory Kit.

2.5 REPACKING FOR SHIPMENT

To protect the unit during reshipment always use the best packaging methods available. When possible, use the original packing containers and cushioning material. Make certain the plug-in RF Unit is

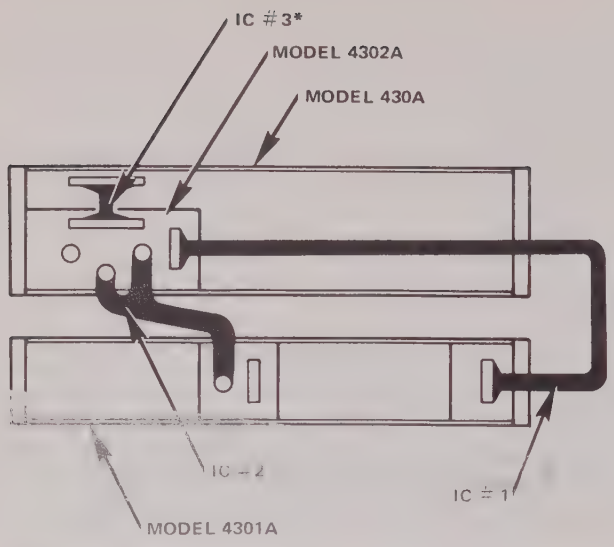


Figure 2-1. Interconnection Cabling Diagram for Rear Panels of Model 430A, Model 4301A and Model 4302A

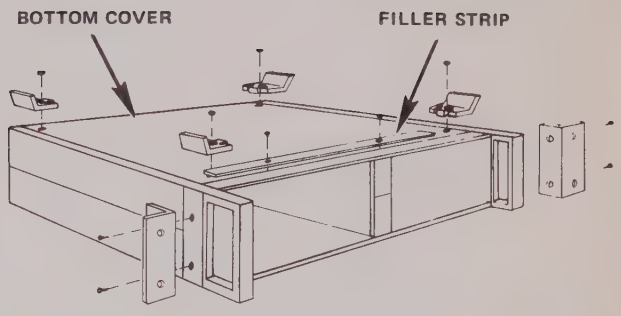


Figure 2-2. Conversion for Rack Mounting Model 4301A

securely locked in position and held there by cushioning material, if installed in the Model 4301A during shipment. If the original packing materials are not available use the following procedure:

a. Wrap instrument in sturdy paper or plastic.

b. Place wrapped instrument in a strong shipping container; use a 3/4-inch layer of shock absorbing material around all sides of the unit to provide a firm cushion and prevent movement inside the container.

c. Thoroughly seal shipping container and mark it as "FRAGILE".

d. If shipping for service attach a tag to indicate:

1. Service required.
2. Description of malfunction.
3. Model and Serial numbers.
4. Return address.
5. Authorization to conduct repairs.

*Refer to Model 4302A Operation and Service Manual for terminal connection information.

SECTION 3

OPERATING INSTRUCTIONS

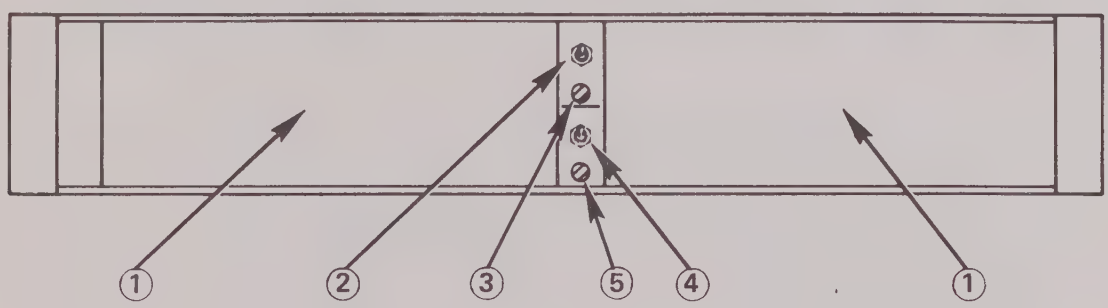
3.1 INTRODUCTION

The Model 4301A is a modular building block designed for increasing the number of RF Units that can be controlled by a single sweeper system. Only one of the two RF units installed in the Model 4301A is energized at any given instant. The activated RF unit operates as though it were plugged directly into the Model 430A Mainframe.

3.2 FRONT AND REAR PANEL FAMILIARIZATION

3.2.1 Front Panel

Figure 3-1 illustrates and explains the function of front panel controls.



(1) **RF Plug-In Unit:** Oscillator source for Model 430A.

(2) **M1 NORMAL/PRESET (Right Side RF Unit):** Selects either NORMAL M1 control of the Model 430A, or the PRESET M1 controls mode of the Model 4301A to establish the center frequency when SYM 1 or CW 1 functions are used.

(3) **PRESET Frequency Adjust (Right Side RF Unit):** Provides means to position the PRESET M1 frequency anywhere within the limits of the right hand RF unit. (Only effective when M1 NORMAL/PRESET (2) is set to PRESET.

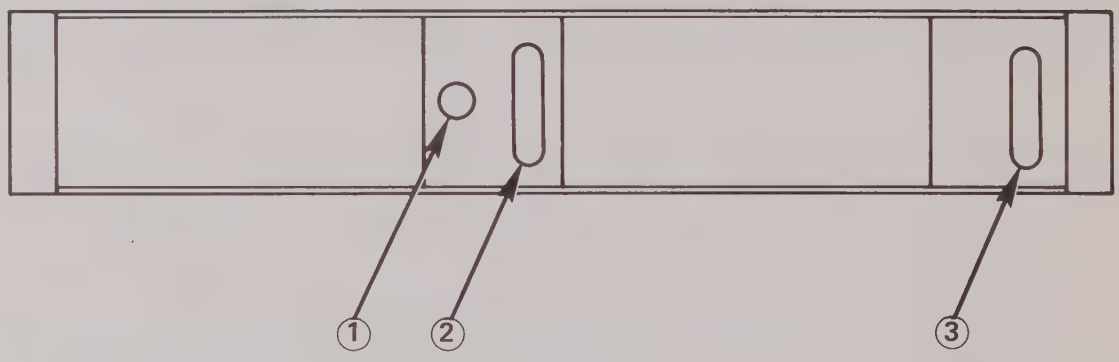
(4) **M1 NORMAL/PRESET (Left Side RF Unit):** Provides same function as (2) but for left side RF unit.

(5) **PRESET Frequency Adjust (Left Side RF Unit):** Provides same function as (3) but for left side RF unit.

Figure 3-1. Front Panel Description

3.2.2 Rear Panel

Figure 3-2 illustrates and identifies connectors located on the rear panel.



① **J5:** Connector for control signals and preset M1 cable from Model 4310A/K Multiband System or the Model 4302A Manual Control Unit.

② **J1:** Connector accepts one end of interconnecting cable from a Model 4302A, or another Model 4301A.

③ **J2:** Connector accepts one end of interconnecting cable from a second Model 4301A if connector ② is already connected to another Model 4302A. Function of connectors ② and ③ are interchangeable.

Figure 3-2. Rear Panel Description

SECTION 4

PRINCIPLES OF OPERATION

4.1 INTRODUCTION

The Model 4301A RF Unit Holder is designed to be used as an interface between a Model 430A Mainframe and multiple operation of RF Units. This section describes the nature of the interconnections made and explains the circuit details.

4.2 BLOCK DIAGRAM DESCRIPTION OF THE SYSTEM

The power and control signals distributed to each of the RF Units are shown in Figure 4-1. The interconnecting cable connector, J1, is connected to the Model 430A & 4302A units which supply the power and control signals. These wires are jumpered across to J2 where they can be connected to a second Model 4301A RF Unit Holder.

The wires from J1 are depicted as two groups. Group A, is directly connected to the RF Unit, thereby feeding all RF Units in parallel. A second, group B, contain wires which are selectively connected to the RF units via solid state switches so that only one RF unit is connected to group B at any given time.

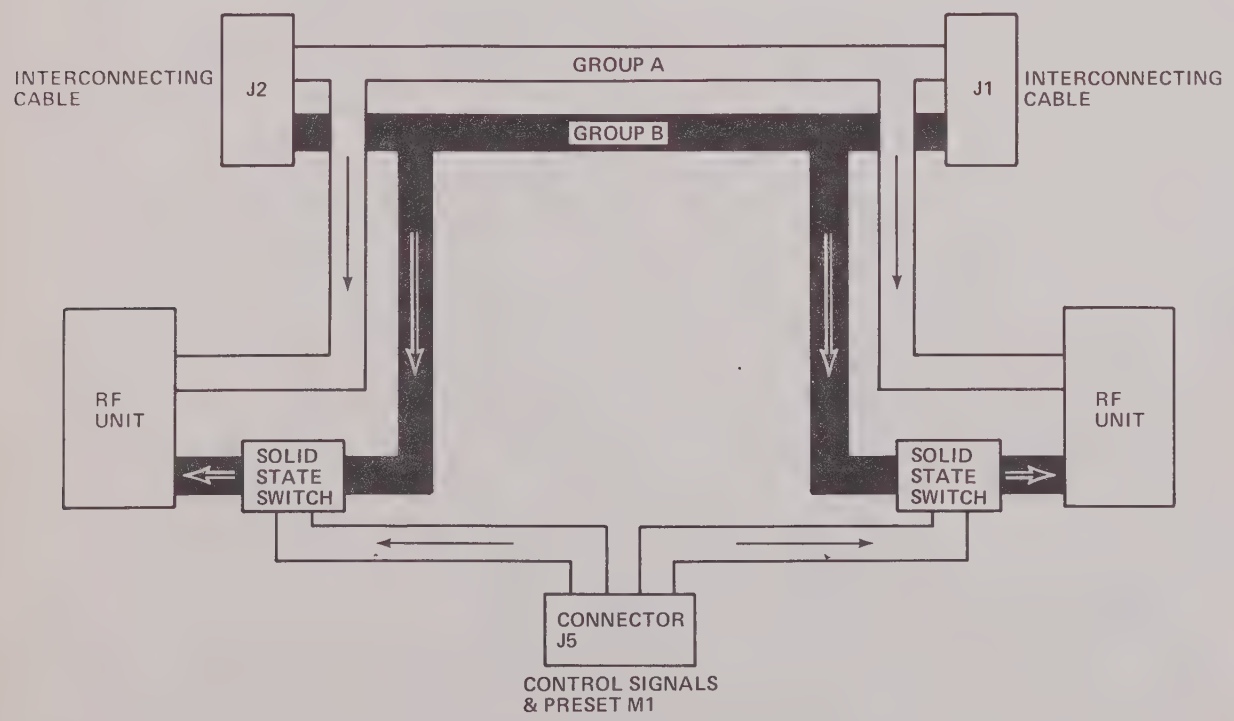


Figure 4-1. Block Daigram of Model 4301A

The solid state switches are controlled by signals received from the 4302A via connector J5.

To provide assistance in identifying each wire, and its function, Figure 4-2 shows which wires are through connections (group A) and which are switched (group B).

4.3 SOLID STATE SWITCHES

The solid state switches in the Model 4301A are operated in the same way as the switches operate in the Model 4310A/K Multiband Unit. A simplified schematic of the solid state switch is shown in Figure 4-3. Two signals, A_X and C_X control the switches. Two types of switches, transistor and reed relay, are used. The reed realys are used in those circuits which are only switched for single band operation, and therefore will not chatter as would be the case for a function that had to be switched for multiband operation. In addition, the reed relays are used only in those circuits which would be adversely affected by temperature-sensitive transistor voltage drops.

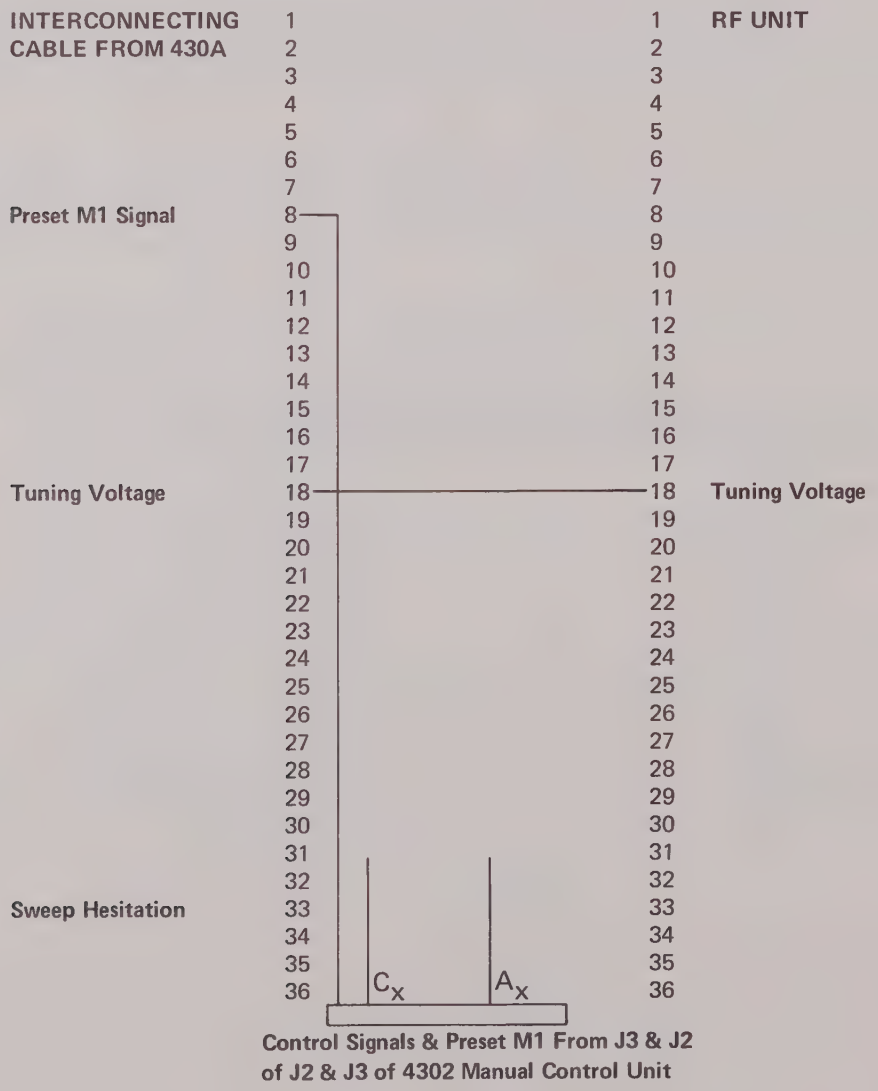

INTERCONNECTING CABLE FROM 430A
RF UNIT
Preset M1 Signal
Tuning Voltage
Tuning Voltage
Sweep Hesitation
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36
C_X
A_X
Control Signals & Preset M1 From J3 & J2
of J2 & J3 of 4302 Manual Control Unit

Figure 4-2. Wiring Identification

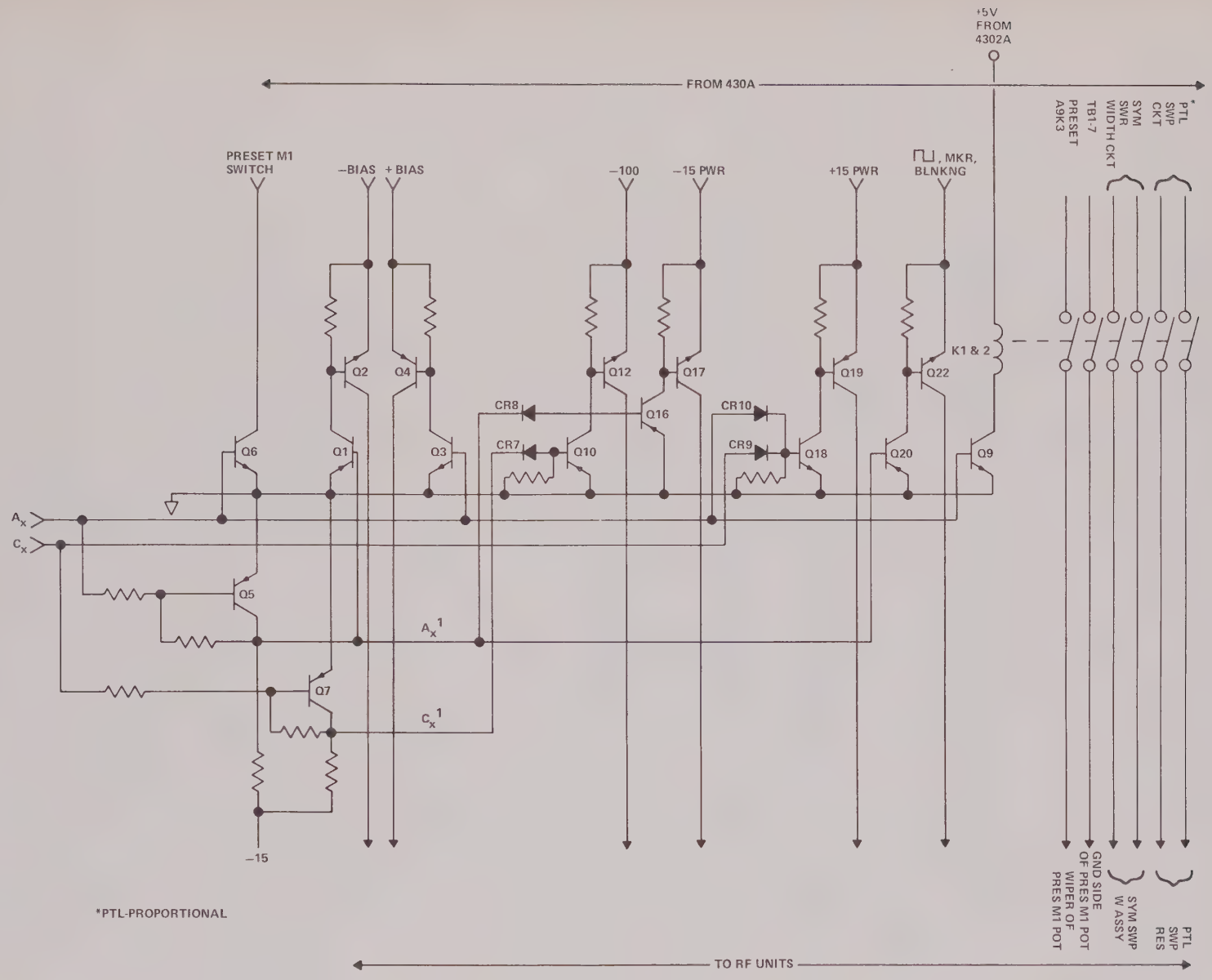


Figure 4-3. Solid State Switch, Simplified Schematic Diagram

The C_X signal is used in the wideband mode of the multiband system to turn on the +15V, −15 V and −100V power to the RF unit in the time slot previous to its being called on by the A_X signal. An example of how the transistor switching occurs can be seen as the positive C_X signal causes Q18 to conduct, making the base of Q19 more negative, causing Q19 to turn full on. Q19 is a transistor designed for high current-carrying capacity and low voltage drop from collector to emitter. The remaining switches are controlled by the A_X signal or its complement A_X'.

4.4 PRESET M1

With the SWEEP FUNCTION selector of the Model 430A Mainframe in either the SYM M1 or CW M1 positions, an alternative M1 control is available on the 4301A RF Unit Holder. If the front panel switch on the Model 4301A is in NORMAL, the M1 control on the Model 430A Mainframe is wired into the circuit. If, however, the switch is in PRESET the front panel potentiometer of the Model 4301A is wired into the circuit.

A simplified schematic diagram illustrating the Preset M1 circuitry is shown in Figure 4-4. Interconnecting cable IC#3 (also identified in Figure 2-2) is used to connect the M1 potentiometer and the control signals to the solid state switches in the Model 4301A.

When the M1 control is activated, as described above, a +5 volt level is applied to pin 8 of the interconnecting cable IC#1. If the PRESET switch is in the PRESET position and the corresponding A_X signal is high, Q6 conducts, thereby energizing relay A1K1 in the Model 4302A and placing it in the PRESET position.

With these control inputs present, the K1 & K2 relays in the solid state switch are energized since Q9 in the Model 4301A unit is conducting because of the A_X signal. The selected M1 preset potentiometer in the Model 4301A RF Unit Holder is now connected to the M1 circuitry in the Model 430A Mainframe.

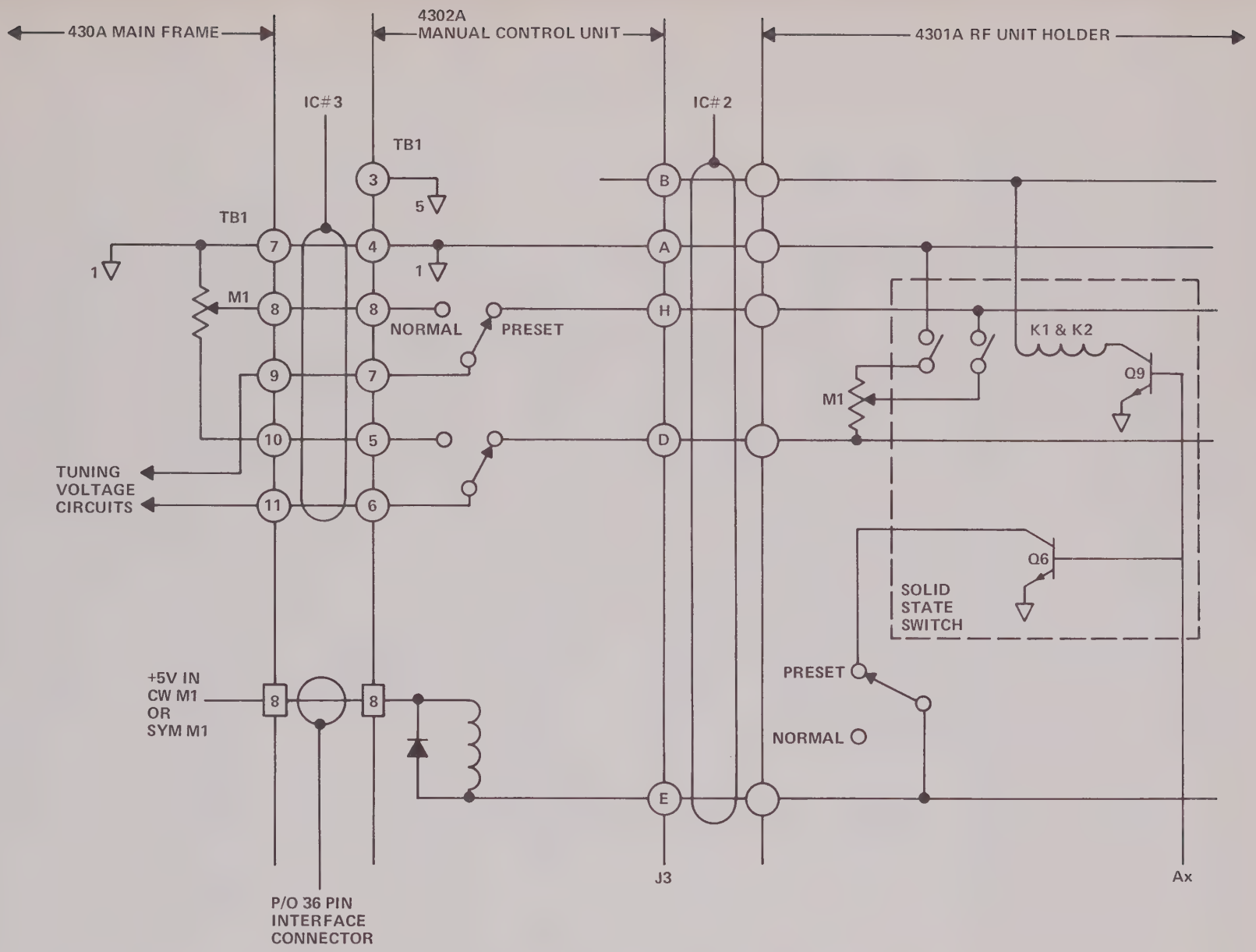


Figure 4-4. Preset M1 Circuitry, Simplified Schematic Diagram

SECTION 5

MAINTENANCE

5.1 INTRODUCTION

This section provides the information required to service and maintain the Model 4301A RF Unit Holder and contains a list of required test equipment and performance tests.

5.2 REQUIRED TEST EQUIPMENT

Test equipment other than those listed in Table 5-1 may be used if their specifications equal or exceed the required characteristics. (Use recently calibrated test equipment.)

Table 5-1. Required Test Equipment

TITLE	REQUIREMENTS	SUGGESTED MFR. AND MODEL NO.
10 dB Attenuator Pad	Calibrated within ±0.1 dB, VSWR 1.3 max.	Weinschel Model 2 or 2A
Crystal Detector	±0.5 dB, 0.01 to 18 GHz	
Oscilloscope	Vertical: DC to at least 300 kHz	Tektronix 516A with 3A9 vertical and 2B67 horizontal plug-ins
Frequency Meter, Reaction Type		
200 - 500 MHz	±0.1% accuracy	Narda 804
500 - 1000 MHz	±0.1% accuracy	Narda 805
1 - 4 GHz	±0.1% accuracy	HP-536A
4 - 12.4 GHz	±0.1% accuracy	HP-537A
12.4 - 18.0 GHz	±0.1% accuracy	HP-P532A

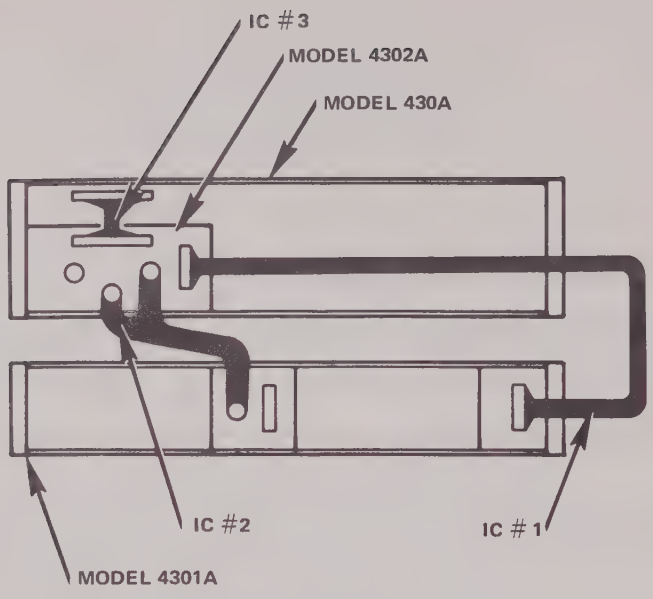
5.3 PERFORMANCE TESTS

The following performance tests provide a method to verify whether the Model 4301A is operating according to the specifications given in Table1-1. The tests should be used as part of the incoming inspection, as a periodic maintenance check or after service has been performed.

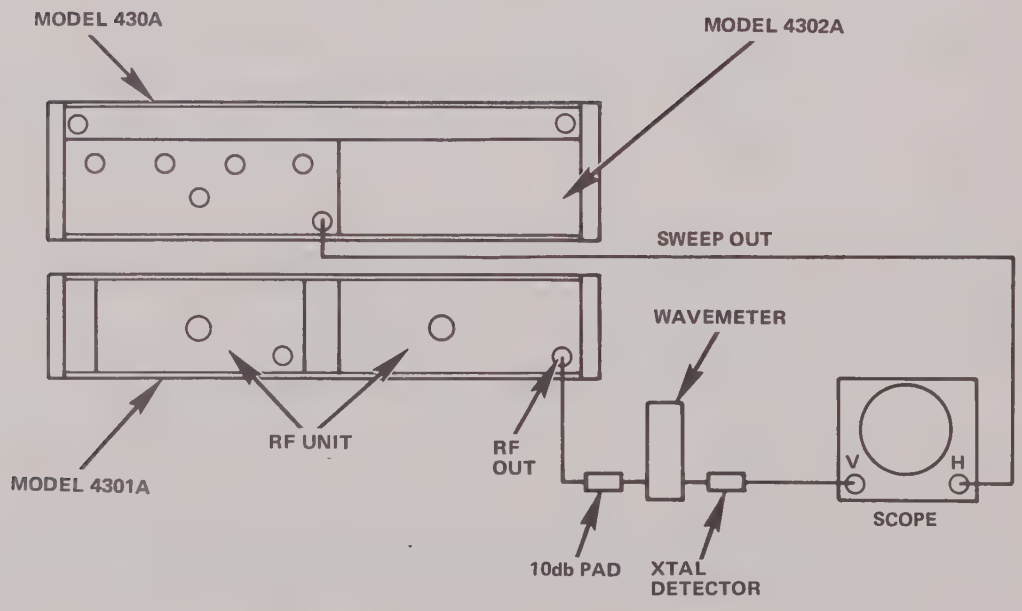
5.3.1 Holder Location Selection

a. Connect the equipment as shown in Figures 5-1A and 5-1B.

b. Set the Model 4302A CONTROL UNIT BAND SELECT to energize a particular RF Unit. If the RF ON/OFF switch on the front panel of the RF Unit under test is set to the ON



A



B

Figure 5-1. Equipment Set-Up for Performance Tests

position, the RF ON lamp should illuminate when the appropriate BAND SELECTOR pushbutton is depressed.

c. Check all other BAND SELECTOR pushbuttons to ensure that each one energizes the correct RF Unit and at no time is there more than one RF Unit energized.

5.3.2 Supply Voltage Switching

a. Connect the equipment as shown in Figures 5-1A and 5-1B.

b. Connect extender cable IC#1 to only J1 on the rear panel of the Model 4301A.

c. On the Model 4302A, depress the appropriate BAND SELECTOR pushbutton required to energize the RF Unit installed in left-hand side of the Model 4301A.

CAUTION

Extreme care must be exercised while performing the following steps to avoid short circuiting pins of the extender cable.

d. Measure voltages on the pins of the unconnected end of cable IC#1 as indicated in Table 5-2. All thirty-six pins of this connector are identified in Table 5-3.

e. While measuring the voltages as described in Table 5-2, sequentially depress the remaining BAND SELECTOR pushbuttons and check to see that the voltages which are not switched are always present. Switched voltages should only be present when that specific receptacle is energized.

f. Connect cable IC#1 to J2 on the rear panel of the Model 4301A and depress the BAND SELECTOR pushbutton required to energize the RF Unit installed in the right-hand side of the Model 4301A.

g. Repeat steps d. and e.

5.3.3 Modulation Switching

a. Repeat steps 5.3.2 a. through c.

b. Connect the oscilloscope to the free end of the extender cable between pins 32 and 29 (return, GND).

c. Set the Model 430A Sweep Oscillator Mainframe front panel 1 KHz ⊓⊔ switch to ON. The 1 KHz square wave, approximately 10V peak-to-peak, should be present on the oscilloscope.

d. Depress the remaining BAND SELECTOR pushbuttons on the Model 4302A. The square wave should not be present. It is, however, normal and permissible for residual "spikes" to be present.

5.3.4 Symmetrical Sweep

a. Connect the equipment as shown in Figures 5-1A and 5-1B.

b. Install an RF Unit in the Model 4301A.

c. Set Model 430A controls as follows:

TRIGGER	LINE
SWEEP FUNCTION	SYM M1
SWEEP TIME (SEC)	.01, both knobs fully clockwise center of scale

d. Set the front panel RF Unit controls as follows:

RF ON/OFF	ON
RF LEVEL	Fully cw
LEVELER MODE	OFF

e. Set the NORMAL/PRESET toggle switches on the Model 4301A under test to NORMAL.

f. On the Model 4302A, depress the appropriate BAND SELECTOR pushbutton to energize the RF Unit. The front panel SYMMETRICAL SWEEP WIDTH and the M1 controls (for setting center frequency) on the Model 430A should be functional.

5.3.5 Preset M1 Function

a. Repeat steps 5.3.4 a. through d.

b. Set the frequency meter dip to mid-display. Change the setting of the Model 430A front panel M1 control. The display should shift correspondingly.

c. Set the Model 4301A front panel M1 switch to PRESET and change setting of the associated trimpot adjust. The display should shift correspondingly.

NOTE

The M1 control on the Model 430A Mainframe should not be functional when the Model 4301A is in the PRESET M1 mode.

5.3.6 Reference Sweep

a. Repeat steps 5.3.4 a. through d.

b. Connect the oscilloscope input to the PROPORTIONAL OUTPUT BNC connector on the rear panel of the Model 430A.

c. Set Model 430A controls as follows:

TRIGGER	LINE
SWEEP FUNCTION	F1-F2
SWEEP TIME (SEC)	.01
F1	lower limit
F2	upper limit
PROPORTIONAL	40v/octave

d. Set Depress appropriate BAND SELECTOR pushbutton on the Model 4302A to energize the selected RF Unit.

e. The proportional sweep waveform should start at +1(±1) volt and finish at +40(±3) volts per octave of the RF Unit frequency coverage.

Table 5-2. Cable IC#1 Voltage Levels

CONNECT VOLTMETER BETWEEN PINS	VOLTMETER READING	SWITCHED (Via Solid State Switch Board)
1 (+) and 2 (–)	5 ±0.5 volts DC	NO
4 (–) and 5 (–)	32 ±4 volts DC	YES
6 (AC) and 7 (AC)	115 ±10 volts AC	NO
19 (–) and 20 (+)	100 ±10 volts DC	YES
24 (+) and 25 (–)	28 ±4 volts DC	NO
29 (–) and 30 (+)	15 ±0.3 volts DC	YES
29 (+) and 31 (–)	15 ±0.3 volts DC	YES
12 (–) and 34 (+)	15 ±0.01 volts DC	NO
34 (–) and 35 (+)	15 ±0.01 volts DC	NO
34 (+) and 36 (–)	15 ±0.01 volts DC	NO

Table 5-3. PIN Identification for Cable IC#1

PIN NO.'s	SIGNAL
1	+5 volts
2	⑤ 5 volt return (GND)
3	Chassis GND
4	(–) } Unregulated input to bias supply (RF units)
5	(+) }
6	} 115 VAC Fan Motor (Not used in RF Units)
7	}
8	M.B. Relay Signal
9	Remote RF ON/OFF Signal
10	Not Used
11	Ax "ON" Signal
12	–15V Ref No. 2
13	NULL } Symmetrical Sweep Resistor
14	OUTPUT }
15	NULL } Proportional Sweep Resistor
16	OUTPUT }
17	② Tuning Voltage Return (GND)
18	Tuning Voltage Signal
19	(–) } Unregulated 100V DC
20	(+) }
21	}
22	} Not Used
23	}
24	(+) } Unregulated Input to YIG Tuning Supply and Heaters
25	(–) }
26	Not Used
27	Blanking
28	Sweep Response Time
29	⓪ ±15 volt Power Return (GND)
30	+15 volt Power
31	–15 volt Power
32	Marker, , Blanking
33	Sweep Hesitation
34	① ±15 volt Reference Return (GND)
35	+15 volt Reference
36	–15 volt Reference

SECTION 6

REPLACEABLE PARTS

6.1 INTRODUCTION

This section provides information for procuring replaceable parts for the Model 4301A RF Unit Holder. The parts listed include all parts subject to burnout, breakage or deterioration during normal operation of the equipment.

6.2 REFERENCE DESIGNATIONS & ABBREVIATIONS

See Table 6-1 for a complete explanation of reference designations & abbreviations.

6.3 ORDERING INFORMATION

The following information should be included when ordering replacement parts for the Model 4301A RF Unit Holder.

a. The Weinschel Engineering Part Number and Description.

b. The Instrument Model Number and Serial Number.

c. If ordering a part not included in the replaceable parts list, include a complete description of the part, its function and its location within the equipment.

Table 6-1. Abbreviations and Reference Designations

All reference designations for electrical parts will be preceded by a prefix which will indicate the assembly in which it is contained. These prefixed will be identified as follows:

A1 – SOLID STATE SWITCH
A2 – SOLID STATE SWITCH
A3 – INTERCONNECTING BOARD
A4 – TRIMMER BOARD
* – BASIC CHASSIS ASSEMBLY
* – Includes all parts within Basic Chassis Assembly not included in Assembly A1-A4.

ABBREVIATIONS

A	–	Amperes	FWD	–	Forward	PC	–	Printed Circuit
AMPL	–	Amplifier	G	–	Giga = 10^9	PF	–	Pico farads = 10^{-12} farads
AM	–	Amplitude modulation	GRD	–	Ground			
APPROX	–	Approximate	H	–	Henry	P/O	–	Part of
ASS'Y	–	Assembly	Hz	–	Cycle per second	P-P	–	Peak to Peak
AUX	–	Aulilary	IDENT	–	Identification	RECT	–	Rectifier
AVG	–	Average	IMP	–	Impulse	RES	–	Resistance or Resistor
BAL	–	Balance	INT	–	Internal	RET	–	Return
BWO	–	Backward wave oscillator	K	–	Kilo = 10^3	REV	–	Reverse
			LIN	–	Linear	RF	–	Radio Frequency
C	–	Cathode	M	–	Milli = 10^{-3}	RMS	–	Square root of mean square
CAL	–	Calibrator	MAX	–	Maximum			
CCW	–	Counterclockwise	MEG	–	Meg = 10^6	SEC	–	Second
CW	–	Clockwise	MFG	–	Manufacturer	SW	–	Switch
dB	–	Decibel	MIN	–	Minimum	SYM	–	Symmetrical
dBm	–	Decibel (referred to 1 milliwatt in 600 ohms)	N	–	Nano = 10^{-9}	TRIG	–	Trigger
			NC	–	Normally closed	TYP	–	Typical
EXT	–	External	NEG	–	Negative	U	–	Micro = 10^{-6}
F	–	Farad	NO	–	Normally open	V	–	Volt
FIG	–	Figure	Ω	–	Ohm	VAR	–	Variable
FIX	–	Fixed	O	–	Peak	W	–	Watts
FM	–	Frequency Modulate	J	–	Jack	R	–	Resistor
A	–	Assembly	K	–	Relay	S	–	Switch
B	–	Motor	L	–	Inductor	T	–	Transformer
C	–	Capacitor	M	–	Meter	TB	–	Terminal Board
CR	–	Diode	P	–	Plug	V	–	Vacuum
DS	–	Lamp	Q	–	Transistor	X	–	Socket
F	–	Fuse						

Table 6-2. Basic Chassis Assembly, Model 4301A Parts List (D139-186)

REFERENCE DESIGNATION	℄ PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A1		See Table 6-3		
A2		See Table 6-3		
A3		See Table 6-4		
A4		See Table 6-5		
B1	21-17	Fan, Sprite	82877	SP2A2
B2	21-17	Fan, Sprite	82877	SP2A2
J1	62-150	Connector, Receptacle	13511	57-40360
J2	62-150	Connector, Receptacle	13511	57-40360
J3	62-150	Connector, Receptacle	13511	57-20360
J4	62-157	Connector, Receptacle	13511	57-20360
J5	62-76	Connector, Receptacle	13511	126-221

Table 6-3. Assembly A1-A2, Solid State Switch Parts List

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A1-A2	C139-10	Solid State Switch Board Assembly	93459	
A1-A2C1		Not Used		
A1-A2C2		Not Used		
A1-A2C3		Not Used		
A1-A2C4		Not Used		
A1-A2C5	23-12-100	Capacitor, 100 pf, 10%, 200 V		CK05BX101K
A1-A2C6	34-21-100	Capacitor, 100 pf, 10%, 200 V		CK05BX101K
A1-A2CR1	12-51	Diode		1N914B
A1-A2CR2	12-51	Diode		1N914B
A1-A2CR3	12-51	Diode		1N914B
A1-A2CR4	12-51	Diode		1N914B
A1-A2CR5	12-51	Diode		1N914B
A1-A2CR6	12-99	Diode		1N483B
A1-A2CR7	12-51	Diode		1N914B
A1-A2CR8	12-51	Diode		1N914B
A1-A2CR9	12-51	Diode		1N914B
A1-A2CR10	12-51	Diode		1N914B
A1-A2CR11	12-45	Diode		1N270
A1-A2K1	47-31	Relay, 3 Pole Form A		
A1-A2K2	47-31	Relay, 3 Pole Form A		
A1-A2Q1	12-140	Transistor		2N4403
A1-A2Q2	12-185	Transistor	04713	MJE1092
A1-A2Q3	12-139	Transistor		2N4401
A1-A2Q4	12-186	Transistor	04713	MJE1102
A1-A2Q5	12-140	Transistor		2N4403
A1-A2Q6	12-139	Transistor		2N4401
A1-A2Q7	12-140	Transistor		2N4403
A1-A2Q8	12-139	Transistor		2N4401
A1-A2Q9	12-139	Transistor		2N4401
A1-A2Q10	12-210	Transistor	04713	MM4003
A1-A2Q11	12-211	Transistor	04713	MJ421
A1-A2Q12	12-211	Transistor	04713	MJ421
A1-A2Q13		Not Used		
A1-A2Q14		Not Used		
A1-A2Q15		Not Used		
A1-A2Q16	12-140	Transistor		2N4403

Table 6-3. Assembly A1-A2, Solid State Switch Parts List (Cont.)

REFERENCE DESIGNATION	¥ PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A1-A2Q17	12-209	Transistor	04713	MJE205
A1-A2Q18	12-139	Transistor		2N4401
A1-A2Q19	12-208	Transistor	04713	MJE105
A1-A2Q20	12-140	Transistor		2N4403
A1-A2Q21	12-139	Transistor		2N4401
A1-A2Q22	12-139	Transistor		2N4401
A1-A2R1	25-25-3300	Res., film, 3.3K, 5%, ¼W		RC07GF333J
A1-A2R2		Not Used		
A1-A2R3	25-25-470	Res., film, 470 ohm, 5%, ¼W		RC07GF471J
A1-A2R4	25-25-3300	Res., film, 3.3K, 5%, ¼W		RC07GF332J
A1-A2R5	25-25-470	Res., film, 470 ohm, 5%, ¼W		RC07GF471J
A1-A2R6	25-8-560	Res., comp, 560 ohm, 5%, ½W		RC20GF561J
A1-A2R7	25-25-1500	Res., film, 1.5K, 5%, ¼W		RC07GF152J
A1-A2R8	25-25-10K	Res., film, 10K, 5%, ¼W		RC07GF103J
A1-A2R9	25-25-100K	Res., film, 100K, 5%, ¼W		RC07GF104J
A1-A2R10	25-25-22K	Res., film, 22K, 5%, ¼W		RC07GF223J
A1-A2R11	25-25-4700	Res., film, 4.7K, 5%, ¼W		RC07GF472J
A1-A2R12	25-25-1500	Res., film, 1.5K, 5%, ¼W		RC07GF152J
A1-A2R13	25-25-10K	Res., film, 10K, 5%, ¼W		RC07GF103J
A1-A2R14	25-25-100K	Res., film, 100K, 5%, ¼W		RC07GF104J
A1-A2R15	25-25-22K	Res., film, 22K, 5%, ¼W		RC07GF223J
A1-A2R16	25-25-10K	Res., film, 10K, 5%, ¼W		RC07GF103J
A1-A2R17	25-25-330	Res., film, 330 ohm, 5%, ¼W		RC07GF331J
A1-A2R18	25-25-4700	Res., film, 4.7K, 5%, ¼W		RC07GF472J
A1-A2R19	25-25-560K	Res., comp, 560K, 5%, ¼W		RC07GF564J
A1-A2R20	25-25-100K	Res., film, 100K, 5%, ¼W		RC07GF104J
A1-A2R21	25-25-100K	Res., film, 100K, 5%, ¼W		RC07GF104J
A1-A2R22		Not Used		
A1-A2R23		Not Used		
A1-A2R24		Not Used		
A1-A2R25		Not Used		
A1-A2R26	25-25-1000	Res., film, 1K, 5%, ¼W		RC07GF102J
A1-A2R27	25-25-220	Res., film, 220 ohm, 5%, ¼W		RC07GF221J
A1-A2R28	25-25-1000	Res., film, 1K, 5%, ¼W		RC07GF102J
A1-A2R29	25-25-220	Res., film, 220 ohm, 5%, ¼W		RC07GF221J
A1-A2R30	25-25-4700	Res., film, 4.7K, 5%, ¼W		RC07GF472J
A1-A2R31	25-25-4700	Res., film, 4.7K, 5%, ¼W		RC07GF472J

Table 6-3. Assembly A1-A2, Solid State Switch Parts List (Cont.)

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A1-A2R32	25-25-10K	Res., film, 10K, 5%, ¼W		RC07GF103J
A1-A2R33	25-25-10K	Res., film, 10K, 5%, ¼W		RC07GF103J
A1-A2R34	25-25-4700	Res., film, 4.7K, 5%, ¼W		RC07GF472J
A1-A2R35	25-25-4700	Res., film, 4.7K, 5%, ¼W		RC07GF472J
A1-A2R36	25-25-2200	Res., film, 2.2K, 5%, ¼W		RC07GF222J
A1-A2R37	25-25-2200	Res., film, 2.2K, 5%, ¼W		RC07GF222J
A1-A2R38	25-8-180	Res., film, 180 ohm, 5%, ¼W		RC209F181J
A1-A2R39	25-8-280	Res., film, 180 ohm, 5%, ¼W		RC209F181J
A1-A2R40	25-25-6800	Res., film, 6.8K, 5%, ¼W		RC07GF682J
A1-A2R41	25-25-6800	Res., film, 6.8K, 5%, ¼W		RC07GF682J

Table 6-4. Assembly A3, Interconnecting Board Parts List

REFERENCE DESIGNATION	✓ PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A3	D139-183	Interconnecting P.C. Board	93459	
A3J1	62-152	Connector, P.C. Board	07233	252-18-30-160
A3J2	62-152	Connector, P.C. Board	07233	252-18-30-160
A3J3	62-152	Connector, P.C. Board	07233	252-18-30-160
A3J4	62-152	Connector, P.C. Board	07233	252-18-30-160

Table 6-5. Assembly A4, Trimmer Board Parts List

REFERENCE DESIGNATION	✓ PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A4	B139-185	Trimmer Board Assembly	93459	
A4R1	20-189-1000	Res., Var, 1K, 10%, ¾W	73138	89P
A4R2	20-189-1000	Res., Var, 1K, 10%, ¾W	73138	89P

SECTION 7

ASSEMBLY DRAWINGS AND SCHEMATICS

7.1 INTRODUCTION

This section contains assembly drawings, schematic diagrams and component location drawings for the Model 4301A RF Unit Holder assembly and subassemblies.

7.2 LIST OF FIGURES

FIGURE	DESCRIPTION	PAGE
7-1	Model 4301A, Assembly and Component Identification	7-3/7-4
7-2	Model 4301A, Overall Schematic Diagram	7-5
7-3	Solid-State Switch Assembly A1-A2, Schematic Diagram and Component Identification	7-7/7-8
7-4	Interconnecting Board Assembly A3, Component Identification	7-9
7-5	Trimmer Board Assembly A4, Component Identification	7-10

Table 7-1. Schematic Notes

1. Resistance in ohms, capacitance in microfarads unless otherwise indicated.

2. Screwdriver adjustment

Front panel control

3. Front panel designation

Rear panel designation

4. Printed circuit card border

 Main signal path

Semi-Rigid Coaxial

5. P/O = part of

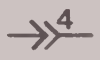
6.

Wiper moves toward CW when control rotated clockwise

7. Test point.

8. Zener diode; SCR

9. Cons. Current Diode

10. 

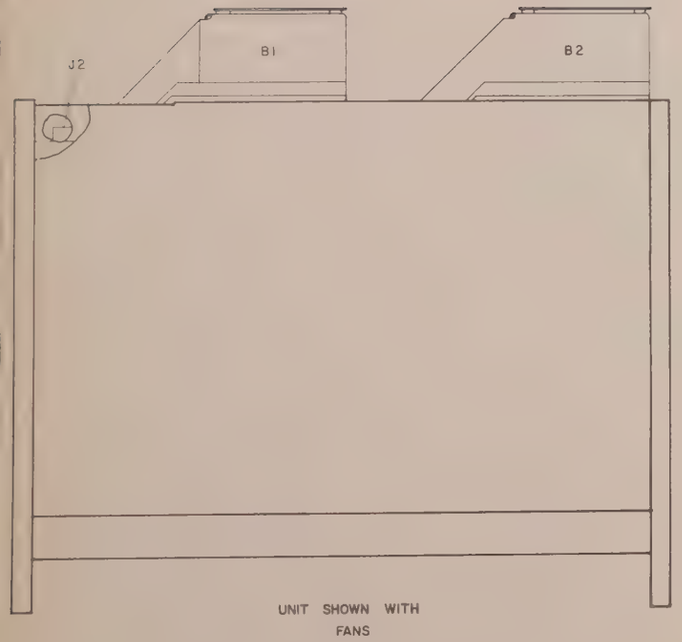
Indicates Socket connections and pin numbers.

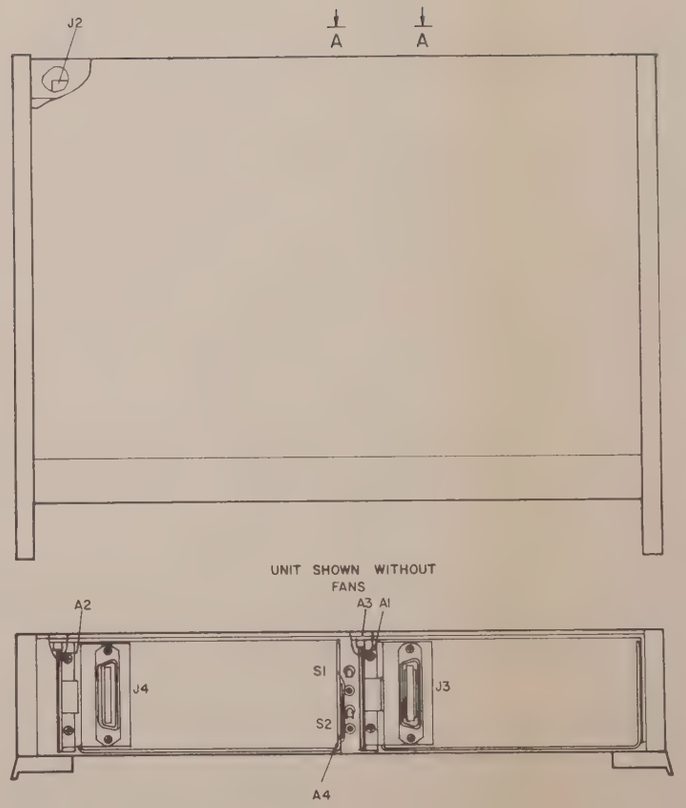
11.

Indicates solder connection and pin numbers.

12. Denotes chassis ground

13. Denotes signal ground





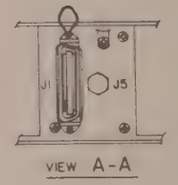


Figure 7-1. Model 4301A, Assembly and Component Identification

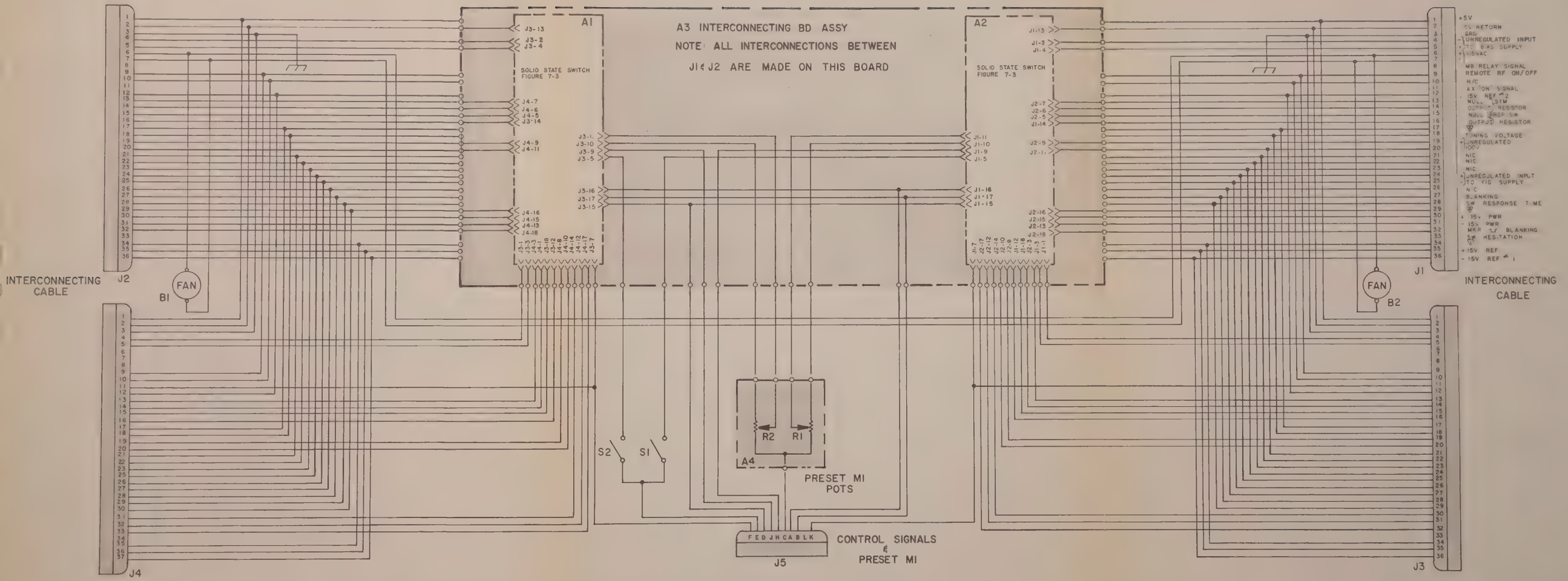
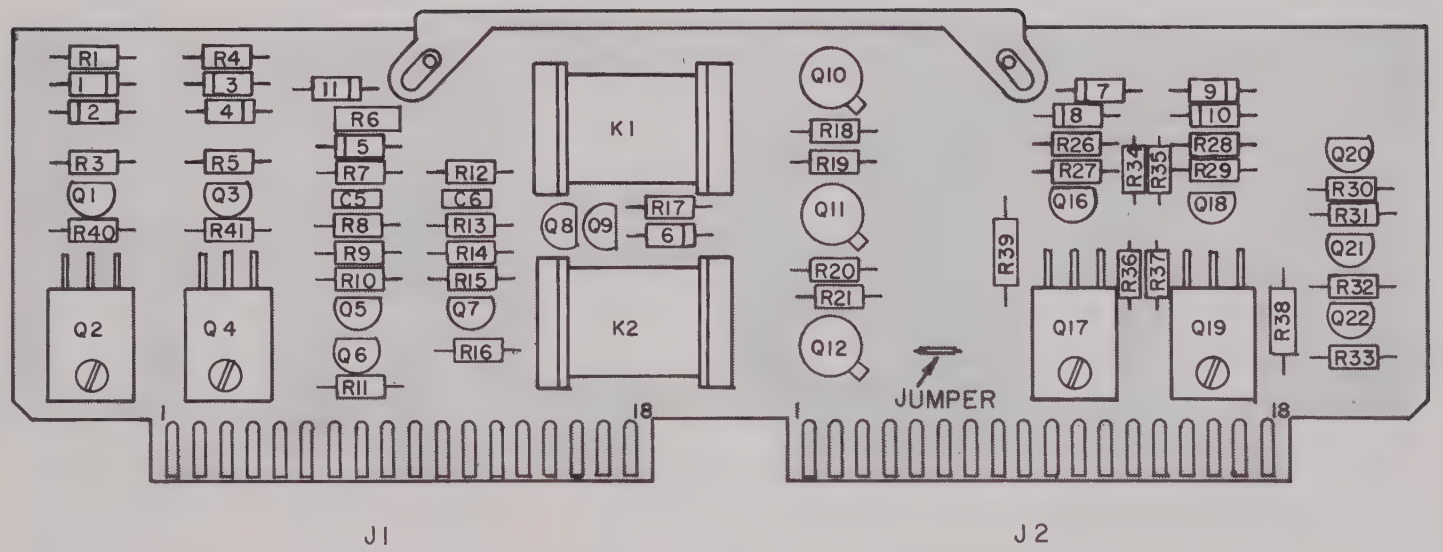
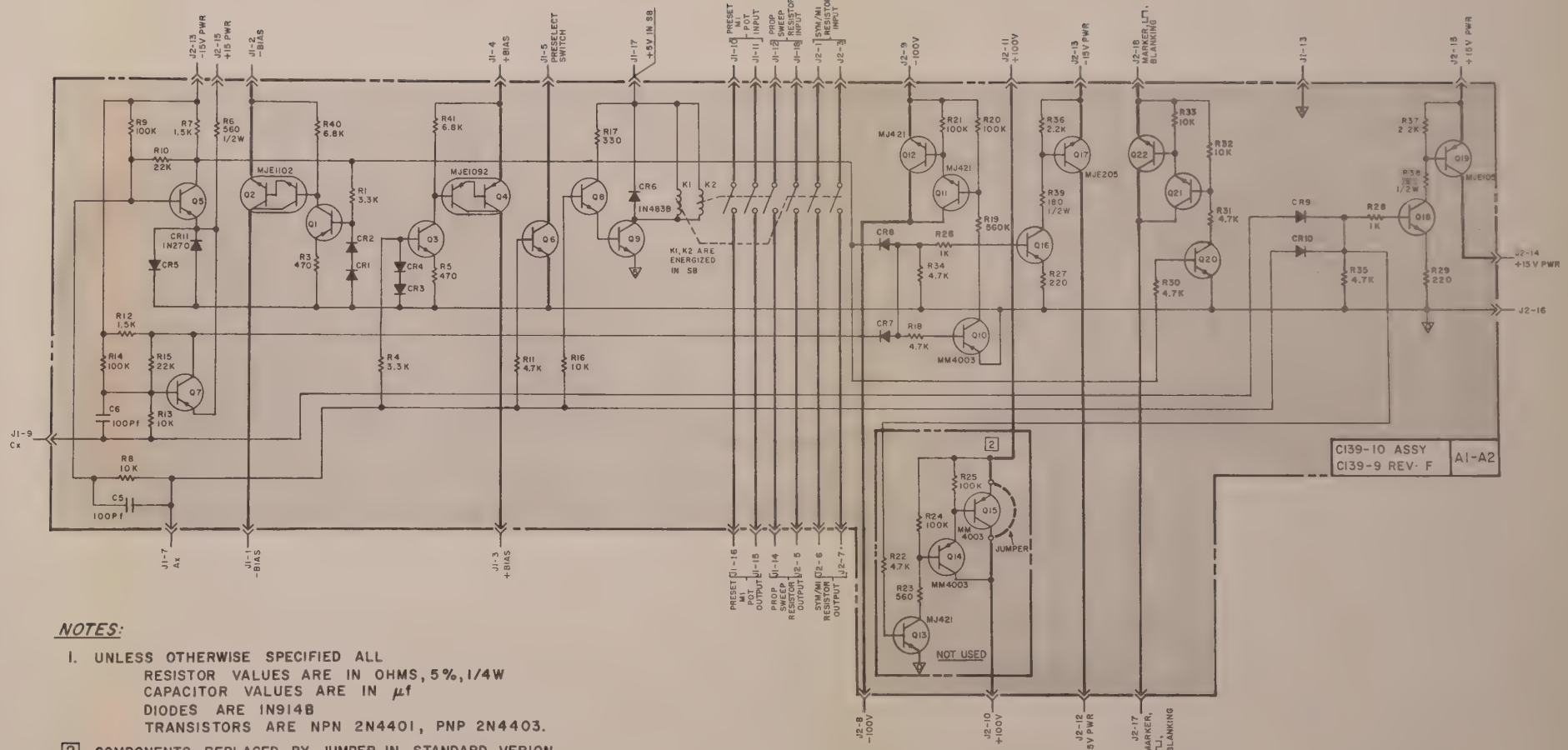


Figure 7-2. Model 4301A, Overall Schematic Diagram



SYM. DES.

1. —|CR|— DIODE



NOTES:

1. UNLESS OTHERWISE SPECIFIED ALL
   RESISTOR VALUES ARE IN OHMS, 5%, 1/4W
   CAPACITOR VALUES ARE IN μf
   DIODES ARE 1N914B
   TRANSISTORS ARE NPN 2N4401, PNP 2N4403.

[2] COMPONENTS REPLACED BY JUMPER IN STANDARD VERION.

Figure 7-3. Solid-State Switch Assembly A1-A2, Schematic Diagram and Component Identification

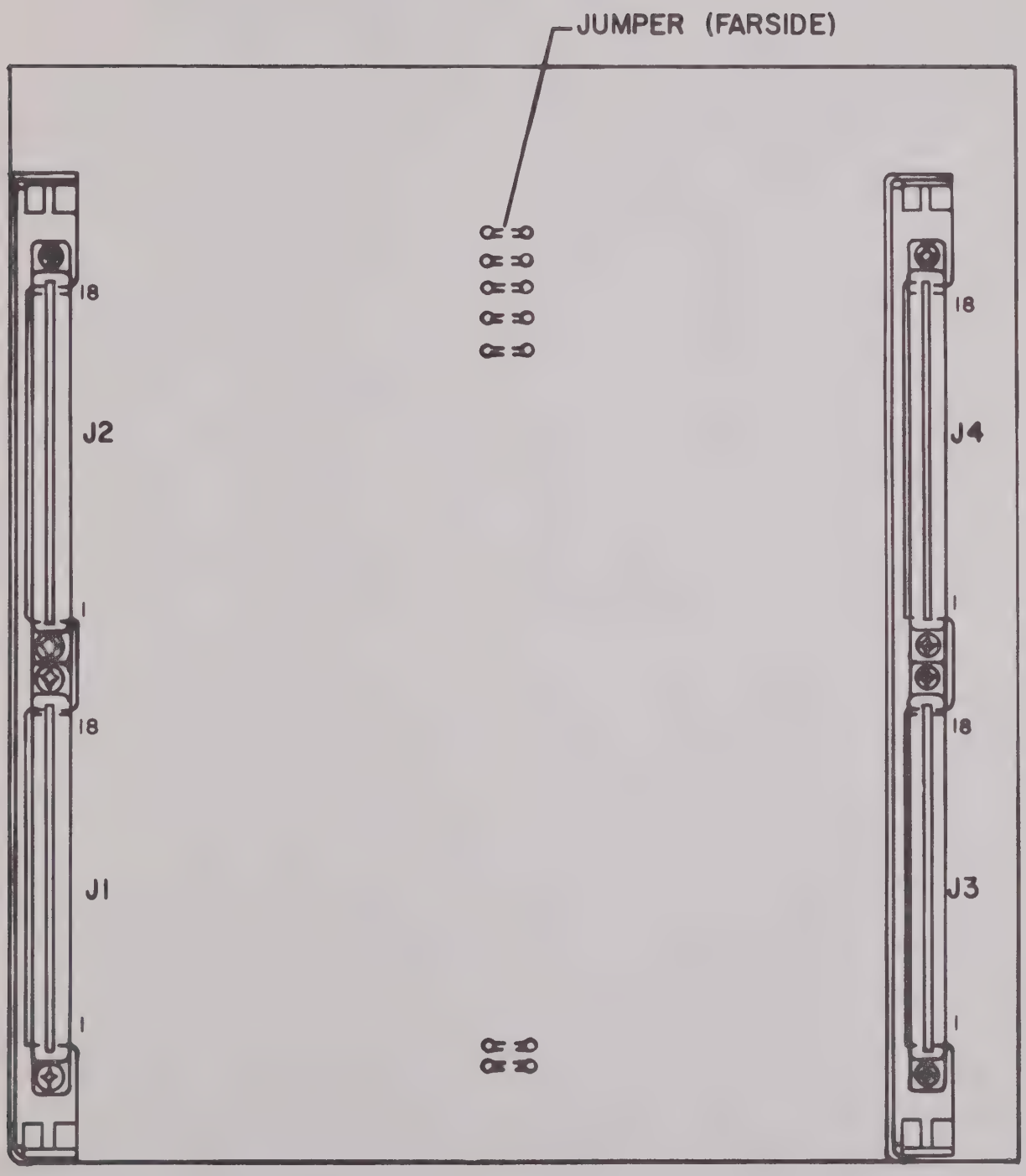


Figure 7-4. Interconnecting Board Assembly A3, Component Identification

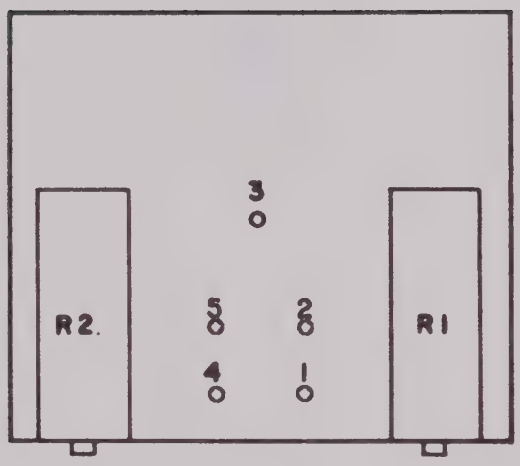


Figure 7-5. Trimmer Board Assembly A4, Component Identification

CODE LIST OF MANUFACTURERS

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 (Name to Code) and H4-2 (Code to Name) and their latest supplements. The date of revision and the date of the supplements used appear at the bottom of each page. Alphabetical codes have been arbitrarily assigned to suppliers not appearing in the H4 Handbooks.

Code No.	Manufacturer/Address
00000	U.S.A. Common: Any supplier of U.S.
00136	McCoy Electronics: Mount Holly Springs, Pa.
00213	Sage Electronics Corp.: Rochester, N.Y.
00287	Cemco Inc.: Danielson, Conn.
00334	Humidial: Colton, Calif.
00348	Microtron Co., Inc.: Valley Stream, N.Y.
00373	Garlock Inc.: Cherry Hill, N.J.
00656	Aerovox Corp.: New Bedford, Mass.
00779	Amp. Inc.: Harrisburg, Pa.
00781	Aircraft Radio Corp.: Boonton, N.J.
00815	Northern Engineering Laboratories, Inc.: Burlington, Wis.
00853	Sangamo Electric Co., Pickens Div.: Pickens, S.C.
00866	Goe Engineering Co.: City of Industry, Calif.
00891	Carl F. Holmes Corp.: Los Angeles, Calif.
00929	Microlab Inc.: Livingston, N.J.
01002	General Electric Co., Capacitor Dept.: Hudson Falls, N.Y.
01009	Alden Products Co.: Brockton, Mass.
01121	Allen Bradley Co.: Milwaukee, Wis.
01255	Litton Industries, Inc.: Beverly Hills, Calif.
01281	TRW Semiconductors, Inc.: Lawndale, Calif.
01295	Texas Instruments, Inc., Transistor Products Div.: Dallas, Texas
01349	The Alliance Mfg. Co.: Alliance, Ohio
01589	Pacific Relays, Inc.: Van Nuys, Calif.
01670	Gudebrod Bros, Silk Co.: New York, N.Y.
01884	Sprague: Longwood, Fla.
01930	Amerock Corp.: Rockford, Ill.
01961	Pulse Engineering Co. : Santa Clara, Calif.
02114	Ferroxcube Corp. of America: Saugerties, N.Y.
02116	Wheelock Signals, Inc.: Long Branch, N.J.
02286	Cole Rubber and Plastics Inc.: Sunnyvale, Calif.
02660	Amphenol-Borg Electronics Corp.: Broadview, Ill.
02735	Radio Corp. of America, Semiconductor and Materials Div.: Somerville, N.J.
02771	Vocaline Co. of America, Inc.: Old Saybrook, Conn.
02777	Hopkins Engineering Co.: San Fernando, Calif.
02875	Hudson Tool & Die Co.: Newark, N.J.
03508	G. E. Semiconductor Prod. Dept.: Syracuse, N.Y.
03705	Apex Machine & Tool Co.: Dayton, Ohio
03797	Eldema Corp.: Compton, Calif.
03818	Parker Seal Co.: Los Angeles, Calif.
03877	Transitron Electric Corp.: Wakefield, Mass.
03888	Pyrofilm Resistor Co., Inc.: Cedar Knolls, N.J.
03954	Singer Co., Diehl Div. Finderne Plant: Sumerville, N.J.
04009	Arrow, Hart and Hegeman Elect. Co.: Hartford, Conn.
04013	Taurus Corp.: Lambertville, N.J.
04062	Arco Electronic Inc.: Great Neck, N.Y.
04222	Hi-Q Division of Aerovox: Myrtle Beach, S.C.
04354	Precision Paper Tube Co.: Wheeling, Ill.
04404	Dymec Division of Hewlett-Packard Co.: Palo Alto, Calif.
04651	Sylvania Electric Products, Microwave Device Div.: Mountain View, Calif.
04673	Dakota Engr. Inc.: Culver City, Calif.
04713	Motorola, Inc., Semiconductor Prod. Div.: Phoenix, Arizona
04732	Filtron Co., Inc. Western Div.: Culver City, Calif.
04773	Automatic Electric Co.: Northlake, Ill.
04796	Sequoia Wire Co.: Redwood City, Calif.
04811	Precision Coil Spring Co. : El Monte, Calif.
04870	P. M. Motor Company: Westchester, Ill.
04919	Component Mfg. Service Co.: W. Bridgewater, Mass.
05006	Twentieth Century Plastics, Inc.: Los Angeles, Calif.
05245	Components Corp.: Chicago, Ill.
05277	Westinghouse Electric Corp., Semi-Conductor Dept. Youngwood, Pa.
05347	Ultronix, Inc.: San Mateo, Calif.
05397	Union Carbide Corp., Elect. Div.: New York, N.Y.
05574	Viking Ind. Inc.: Canoga Park, Calif.
05593	Icore Electro-Plastics Inc.: Sunnyvale, Calif.
05616	Cosmo Plastic (c/o Electrical Spec. Co.): Cleveland, Ohio
05624	Barber Colman Co.: Rockford, Ill.
05728	Tiffen Optical Co.,: Roslyn Heights, Long Island, N.Y.
05729	Metro-Tel Corp.: Westbury, N.Y.
05783	Stewart Engineering Co.: Santa Cruz, Calif.
05820	Wakefield Engineering Inc.: Wakefield, Mass.
06004	Bassick Co., Div. of Stewart Warner Corp.: Bridgeport, Conn.
06090	Raychem Corp.: Redwood City, Calif.
06175	Bausch and Lomb Optical.: Rochester, N.Y.
06402	E.T.A. Products Co. of America: Chicago, Ill.
06540	Amatom Electronic Hardware Co., Inc.: New Rochelle, N.Y.
06555	Beede Electrical Instrument Co., Inc.: Penacook, N.H.
06666	General Devices Co., Inc.: Indianapolis, Ind.
06751	Components Inc., Ariz. Div.: Phoenix, Ariz.
06812	Torrington Mfg. Co., West Div.: Van Nuys, Calif.
06980	Varian Assoc. Eimac Div.: San Carlos, Calif.
07088	Kelvin Electric Co.: Van Nuys, Calif.
07126	Digitran Co.: Pasadena, Calif.
07137	Transistor Electronics Corp.: Minneapolis, Minn.
07138	Westinghouse Electric Corp., Electronic Tube Div.: Elmira, N.Y.
07149	Filmohm Corp.: New York, N.Y.
07233	Cinch-Graphik Co.: City of Industry, Calif.
07256	Silicon Transistor Corp.: Carle Place, N.Y.
07261	Avnet Corp.: Culver City, Calif.
07263	Fairchild Camera & Inst. Corp, Semiconductor Div.: Mountain View, Calif.
07322	Minnesota Rubber Co.: Minneapolis, Minn.
07387	Birtcher Corp., The: Monterey Park, Calif.
07397	Sylvania Elect. Prod. Inc.,: Mt. View Operations: Mountain View, Calif.
07700	Technical Wire Products Inc.: Cranford, N. J.
07829	Bodine Elect. Co.: Chicago, Ill.

LIST OF MANUFACTURERS (Continued)

Code No.	Manufacturer/Address
07910	Continental Device Corp.: Hawthorne, Calif.
07933	Raytheon Mfg. Co., Semiconductor Div.: Mountain View, Calif.
07980	Hewlett-Packard Co., Boonton Radio Div.: Rockaway, N.J.
08145	U.S. Engineering Co.: Los Angeles, California
08289	Blinn, Delbert Co.: Pomona, Calif.
08358	Burgess Battery Co.: Niagara Falls, Ontario, Canada
08524	Deutsch Fastener Corp.: Los Angeles, Calif.
08664	Bristol., The: Waterbury, Conn.
08717	Sloan Company: Sun Valley, Calif.
08718	ITT Cannon Electric Inc., Phoenix Div.: Phoenix, Arizona
08727	National Radio Lab. Inc.: Paramus, N.J.
08792	CBS Electronics Semiconductor Operations, Div. of C. B. S. Inc.: Lowell, Mass.
08806	General Electric Co. Miniat. Lamp Dept.: Cleveland, Ohio
08984	Mel-Rain: Indianapolis, Ind.
09021	Airco Speer: Bedford, Pa.
09026	Babcock Relays Div.: Costa Mesa, Calif.
09134	Texas Capacitor Co.: Houston, Texas
09145	Tech. Ind. Inc. Atohm Elect.: Burbank, Calif.
09250	Electro Assemblies, Inc.: Chicago, Ill.
09353	C & K Components Inc.: Newton, Mass.
09569	Mallory Battery Co. of Canada, Ltd.: Toronto, Ontario, Canada
09922	Burndy Corp.: Norwalk, Conn.
09969	Dale: Yankgon, S.D.
10214	General Transistor Western Corp.: Los Angeles, Calif.
10411	Ti-Tal, Inc.: Berkeley, Calif.
10646	Carborundum Co.: Niagara Falls, N.Y.
11236	CTS of Berne, Inc.: Berne, Ind.
11237	Chicago Telephone of California, Inc.: So. Pasadena, Calif.
11242	Bay State Electronics Corp.: Waltham, Mass.
11312	Teledyne Inc., Microwave Div.: Palo Alto, Calif.
11314	National Seal: Downey, Calif.
11453	Precision Connector Corp.: Jamaica, N.Y.
11534	Duncan Electronics Inc.: Costa Mesa, Calif.
11711	General Instrument Corp., Semiconductor Div., Products Group: Newark, N.J.
11717	Imperial Electronic, Inc.: Buena Park, Calif.
11870	Melabs, Inc.: Palo Alto, Calif.
12040	National Semiconductor: Danbury, Conn.
12136	Philadelphia Handle Co.: Camden, N.J.
12300	Potter and Brumfield: Ontario, Canada
12361	Grove Mfg. Co., Inc.: Shady Grove, Pa.
12574	Gulton Ind. Inc. Data System Div.: Albuquerque, N.M
12697	Clarostat Mfg. Co.: Dover, N.H.
12728	Elmar Filter Corp.: W. Haven, Conn.
12859	Nippon Electric Co., Ltd.: Tokyo, Japan
12881	Metex Electronics Corp.: Clark, N.J.
12930	Delta Semiconductor Inc.: Newport Beach, Calif.
12954	Dickson Electronics Corp.: Scottsdale, Arizona
13103	Thermolloy: Dallas, Texas
13396	Telefunken (GmbH): Hanover, Germany
13511	Amphenol: Gatos, Calif.
13835	Midland-Wright Div. of Pacific Industries, Inc.: Kansas City, Kansas
14099	Sem-Tech: Newbury Park, Calif.
14193	Calif. Resistor Corp.: Santa Monica, Calif.
14298	American Components, Inc.: Conshohocken, Pa.
14433	ITT Semiconductor, A Div. of Int. Telephone & Telegraph Corp.: West Palm Beach, Fla.
14493	Hewlett-Packard Company: Loveland, Colo.
14655	Cornell Dublier Electric Corp.: Newark, N.J.
14674	Corning Glass Works: Corning, N.Y.
14752	Electro Cube Inc.: San Gabriel, Calif.
14960	Williams Mfg. Co: San Jose, Calif.
15203	Webster Electronics Co.: New York, N.Y
15287	Scionics Corp.: Northridge, Calif.
15291	Adjustable Bushing Co.: N. Hollywood, Calif.
15556	Micron Electronics: Garden City, Long Island, N.Y.
15566	Amprobe Inst. Corp.: Lynbrook, N.Y.
15631	Cabletronics: Costa Mesa, Calif.
15772	Twentieth Century Coil Spring Co.,: Santa Clara, Calif
15801	Fenwal Elect. Inc.: Framingham, Mass.
15818	Amelco Inc.: Mt. View, Calif.
16037	Spruce Pine Mica Co.: Spruce Pine, N.C.
16179	Omni-Spectra Inc.: Farmington, Mich.
16352	Computer Diode Corp.: Lodi, N.J.
16585	Boots Aircraft Nut Corp.: Pasadena, Calif.
16688	Ideal Prec. Meter Co., Inc. De Jur Meter Div.: Brooklyn, N.Y.
16758	Delco Radio Div. of G. M. Corp.: Kokoma, Ind
17109	Thermonetics Inc.: Canoga Park, Calif.
17474	Tranex Company: Mountain View, Calif.
17554	Components Inc.: Biddeford, Ma.
17675	Hamlin Metal Products Corp.: Akron, Ohio
17745	Angstrohm Prec. Inc.: No Hollywood, Calif.
17870	McGraw-Edison Co.: Manchester, N.H.
18042	Power Design Pacific Inc.: Palo Alto, Calif.
18083	Clevite Corp., Semiconductor Div.: Palo Alto Calif.
18324	Signetics Corp.: Sunnyvale, Calif.
18476	Ty-Car Mfg. Co., Inc.: Holliston, Mass.
18486	TRW Elect. Comp. Div.: Des Plaines, Ill.
18583	Curtis Instrument, Inc.: Mt. Kisco, N.Y.
18612	Vishay Instruments Inc.: Malvern, Pa.
18873	E. I. DuPont and Co., Inc.: Wilmington, Del.
18911	Durant Mfg. Co.: Milwaukee, Wis.
19315	The Bendix Corp., Navigation & Control Div.: Teterboro N. J.
19500	Thomas A. Edison Industries, Div. of McGraw-Edison Co.: West Orange, N.J.
19589	Concoa: Baldwin Park, Calif.
19644	LRC Electronics: Horseheads, N.Y.
19701	Electra Mfg. Co.: Independence, Kansas
20183	General Atronics Corp.: Philadelphia, Pa.
21226	Executone, Inc.: Long Island City, N.Y.
21335	Fafnir Bearing Co., The: New Britain, Conn.
21520	Fansteel Metallurgical Corp.: N. Chicago, Ill.
23042	Texscan Corp.: Indianapolis, Ind.
23783	British Radio Electronics Ltd.: Washington, D.C
24455	G. E. Lamp Division: Nela Park, Cleveland, Ohio
24655	General Radio Co.: West Concord, Mass.

LIST OF MANUFACTURERS (Continued)

Code No.	Manufacturer/Address
24681	Memcor Inc., Comp. Div.: Huntington, Ind.
24796	Parelco Inc.: San Juan Capistrano, Calif.
26365	Gries Reproducer Corp.: New Rochelle, N.Y.
26462	Grobet File Co. of America, Inc.: Carlstadt, N J
26851	Compac/Hollister Co.: Hollister, Calif.
26992	Hamilton Watch Co.: Lancaster, Pa.
27014	National Semi-Conductor: Santa Clara, Calif.
27251	Specialities Mfg. Co., Inc.: Stratford, Conn.
28480	Hewlett-Packard Co.: Palo Alto, Calif.
28520	Heyman Mfg. Co.: Kenilworth, N. J.
30817	Instrument Sepcialities Co., Inc.: Little Falls, N.J.
31433	Union Carbide: Greenville, S.C.
33173	G. E. Receiving Tube Dept.: Ownesboro, Ky.
35434	Lectrohm Inc.: Chicago, Ill
36196	Stanwyck Coil Products Ltd.: Hawkesbury, Ontario, Canada
36287	Cunningham, W. H. & Hill, Ltd.: Toronto Ontario, Canada
37942	P. R. Mallory & Co. Inc.: Indianapolis, Ind.
39543	Mechanical Industries Prod. Co.: Akron, Ohio
40920	Miniature Precision Bearings, Inc.: Keene, N. H.
42190	Muter Co.: Chicago, Ill.
43990	C. A. Norgren Co.: Englewood, Colo.
44655	Ohmite Mfg. Co.: Skokie, Ill.
46384	Penn Eng. & Mfg. Corp.: Doylestown, Pa.
47904	Polaroid Corp.: Cambridge, Mass.
48620	Precision Thermometer & Inst. Co.: Southampton, Pa.
49956	Microwave & Power Tube Div.: Waltham, Mass.
50139	Allen Bradley: Salt Lake City, Utah
50434	Hewlett-Packard Co.: Palo Alto, Calif.
52090	Rowan Controller Co.: Westminster, Md.
53983	Sanborn Company: Waltham, Mass.
54294	Shallcross Mfg. Co.: Selma, N.C.
55026	Simpson Electric Co.: Chicago, Ill.
55933	Sonotone Corp.: Elmsford, N.Y.
55938	Raytheon Co. Commercial Apparatus & Systems Div.: So. Norwalk, Conn.
56137	Spaulding Fibre Co., Inc. Tonawanda, N.Y.
56289	Sprague Electric Co.: North Adams, Mass.
59446	Telex Corp.: Tulsa, Okla.
59730	Thomas & Betts Co.: Elizabeth, N.J.
60741	Triplett Electrical Inst. Co.: Bluffton, Ohio
61775	Union Switch and Signal, Div. of Westinghouse Air Brake Co.: Pittsburgh, Pa.
62119	Universal Electric Co.: Owosso, Mich.
63743	Ward-Leonard Electric Co.: Mt. Vernon, N.Y.
64959	Western Electric Co., Inc.: New York, N.Y.
65092	Weston Inst. Inc. Weston-Newark: Newark, N.J.
66295	Wittek Mfg. Co.: Chicago, Ill.
66346	Minnesota Mining & Mfg. Co. Revere Mincom Div.: St. Paul, Minn.
70109	Adams and Westlake: Elkhart, Ind.
70276	Allen Mfg. Co.: Hartford, Conn.
70309	Allied Control: New York, N.Y.
70318	Allmetal Screw Product Co., Inc.: Garden City, N.Y.
70417	Amplex, Div. of Chrysler Corp. Detroit, Mich.
70485	Atlantic India Rubber Works, Inc.: Chicago, Ill.
70563	Amperite Co., Inc.: Union City, N.J.
70674	ADC Products Inc.: Minneapolis, Minn.
70903	Belden Mfg. Co.: Chicago, Ill.
70998	Bird Electronic Corp.: Cleveland, Ohio
71002	Birnbach Radio Co.: New York, N.Y.
71034	Bliley Electric Co., Inc.: Erie, Pa.
71041	Boston Gear Works Div. of Murray Co. of Texas: Quincy, Mass.
71218	Bud Radio, Inc.: Willoughby, Ohio.
71279	Cambridge Thermionics Corp.: Cambridge, Mass.
71286	Camloc Fastener Corp.: Paramus, N.J.
71313	Cardwell Condenser Corp.: Lindenhurst, L.I., N.Y.
71400	Bussmann Mfg. Div. of McGraw-Edison Co.: St. Louis, Mo.
71436	Chicago Condenser Corp.: Chicago, Ill.
71447	Calif. Spring Co., Inc.: Pico-Rivera, Calif.
71450	CTS Corp.: Elkhart, Ind.
71468	ITT Cannon Electric Inc.: Los Angeles, Calif.
71471	Cinema, Div. Aerovox Corp.: Burbank, Calif:
71482	C. P. Glare & Co.: Chicago, Ill.
71590	Centralab Div. of Globe Union Inc. Milwaukee, Wis.
71616	Commercial Plastics Co.: Chicago, Ill.
71700	Cornish Wire Co., The: New York, N.Y.
71707	Coto Coil Co., Inc.: Providence, R.I.
71744	Chicago Miniature Lamp Works: Chicago, Ill.
71785	Cinch Mfg. Co., Howard B. Jones Div.: Chicago, Ill.
71984	Dow Corning Corp.: Midland, Mich.
72136	Electro Motive Mfg. Co., Inc.: Willimantic, Conn.
72619	Dialight Corp.: Brooklyn, N.Y.
72656	Indiana General Corp., Electronics Div.: Keasby, N.J.
72699	General Instrument Corp., Cap. Div. Newark, N.J.
72765	Drake Mfg. Co.: Harwood Heights, Ill.
72825	Hugh H. Eby Inc.: Philadelphia, Pa.
72928	Gudeman Co.: Chicago, Ill.
72962	Elastic Stop Nut Corp.: Union,N.J.
72964	Robert M. Hadley Co.: Los Angeles, Calif.
72982	Erie Technological Products, Inc.: Erie, Pa.
73061	Hansen Mfg. Co., Inc.: Princeton, Ind.
73076	H. M. Harper Co.: Chicago, Ill.
73138	Helipot Div. of Beckman Inst., Inc.: Fullerton, Calif.
73293	Hughes Products Division of Hughes Aricraft Co.: Newport Beach, Calif.
73445	Amperex Elect. Co.: Hicksville, L.I., N.Y.
73506	Bradley Semiconductor Corp.: New Haven, Conn.
73559	Carling Electric, Inc.: Hartford, Conn.
73586	Circle F. Mfg. Co.: Trenton, N.J.
73682	George K. Garrett Co., Div. MSL Industries Inc.: Philadelphia, Pa.
73734	Federal Screw Products Inc.: Chicago, Ill.
73743	Fischer Special Mfg. Co.: Cincinnati, Ohio
73793	General Industries Co., The: Elyria, Ohio
73846	Goshen Stamping & Tool Co.: Goshen, Ind.
73899	JFD Electronics Corp.: Brooklyn, N.Y.
73905	Jennings Radio Mfg. Corp.: San Jose, Calif.
73957	Groov-Pin Corp.: Ridgefield, N.J.
74276	Signalite Inc.: Nepture, N.J.
74455	J. H. Winns, and Sons: Winchester, Mass.
74861	Industrial Condenser Corp.: Chicago, Ill.
74868	R. F. Products Division of Amphenol-Borg Electronics Corp.: Danbury, Conn.

LIST OF MANUFACTURERS (Continued)

Code No.	Manufacturer/Address
74970	E. F. Johnson Co.: Waseca, Minn.
75042	International Resistance Co.: Philadelphia, Pa.
75263	Keystone Carbon Co., Inc.: St. Marys, Pa.
75378	CTS Knights Inc.: Sandwich, Ill.
75382	Kulka Electric Corporation: Mt. Vernon, N.Y.
75818	Lenz Electric Mfg. Co.: Chicago, Ill.
75915	Littlefuse, Inc.: Des Plaines, Ill.
76005	Lord Mfg. Co.: Erie, Pa.
76210	C. W. Marwedel: San Francisco, Calif.
76433	General Instrument Corp., Micamold Division: Newark, N.J.
76487	James Millen Mfg. Co., Inc.: Malden, Mass.
76493	J. W. Miller Co.: Los Angeles, Calif.
76530	Cinch-Monadnock, Div. of United Carr Fastener Corp.: San Leandro, Calif.
76545	Mueller Electric Co.: Cleveland, Ohio
76703	National Union: Newark, N.J.
76854	Oak Manufacturing Co.: Crystal Lake, Ill.
77068	The Bendix Corp., Electrodynamics Div.: N. Hollywood, Calif.
77075	Pacific Metals Co.: San Francisco, Calif.
77221	Phanostran Instrument and Electronic Co.: South Pasadena, Calif.
77252	Philadelphia Steel and Wire Corp.: Philadelphia, Pa.
77342	American Machine & Foundry Co. Potter & Brumfield Div.: Princeton, Ind.
77630	TRW Electronic Components Div.: Camden, N.J.
77638	General Instrument Corp., Rectifier Div.: Brooklyn, N.Y.
77764	Resistance Products Co.: Harrisburg, Pa.
77969	Rubbercraft Corp. of Calif.: Torrance, Calif.
78189	Shakeproof Division of Illinois Tool Works: Elgin, Ill.
78277	Sigma: S. Braintree, Mass.
78283	Signal Indicator Corp.: New York, N.Y.
78290	Struthers–Dunn Inc.: Pitman, N.J.
78424	Speciality Leather Prod. Co.: Newark, N.J.
78452	Thompson-Bremer & Co.: Chicago, Ill.
78471	Tilley Mfg. Co.: San Francisco, Calif.
78488	Stackpole Carbon Co.: St. Marys, Pa.
78493	Standard Thomson Corp.: Waltham, Mass.
78553	Tinnerman Products, Inc.: Cleveland, Ohio
78790	Transformer Engineers: San Gabriel, Calif.
78947	Ucinite Co.: Newtonville, Mass.
79136	Waldes Kohinoor Inc.: Long Island City, N.Y.
79142	Veeder Root, Inc.: Hartford, Conn.
79251	Wenco Mfg. Co.: Chicago, Ill.
79727	Continental-Wirt Electronics Corp.: Philadelphia, Pa.
79963	Zierick Mfg. Corp.: New Rochelle, N.Y.
80031	Mepco Division of Sessions Clock Co.: Morristown, N.J.
80120	Schnitzer Alloy Products Co.: Elizabeth, N.J.
80131	Electronic Industries Association. Any brand Tube meeting EIA Standards: Washington, D.C.
80207	Unimax Switch, Div. Maxon Electronics Corp.: Wallingford, Conn.
80223	United Transformer Corp.: New York, N.Y.
80248	Oxford Electric Corp.: Chicago, Ill.
80294	Bourns Inc.: Riverside, Calif.
80411	Acro Div. of Robertshaw Controls Co.: Columbus, Ohio
80486	All Star Products Inc.: Defiance, Ohio
80509	Avery Label Co.: Monrovia, California
80583	Hammerlund Co., Inc.: Mars Hill, N.C.
80640	Stevens, Arnold, Co., Inc.: Boston, Mass.
80813	Dimco Gray Co.: Dayton, Ohio
81030	International Instruments Inc.: Orange, Conn.
81073	Grayhill Co.: LaGrange, Ill.
81095	Triad Transformer Corp.: Venice, Calif.
81312	Winchester Elec, Div. Litton Ind., Inc.: Oakville, Conn.
81349	Military Specification
81483	International Rectifier Corp.: El Segundo, Calif.
81541	Airpax Electronics, Inc.: Cambridge, Maryland
81860	Barry Controls, Div. Barry Wright Corp.: Watertown, Mass.
82042	Carter Precision Electric Co.: Skokie, Ill.
82047	Sperti Faraday Inc., Copper Hewitt Electric Div.: Hoboken, N.J.
82116	Electric Regulator Corp.: Norwalk, Conn.
82142	Jeffers Electronics Division of Speer Carbon Co.: DuBois, Pa.
82170	Fairchild Camera & Inst. Corp. Space & Defense System Div.: Paramus, N.J.
82209	Maguire Industries, Inc.: Greenwich, Conn.
82219	Sylvania Electric Prod. Inc. Electronic Tube Division: Emporium, Pa.
82376	Astron Corp.: East Newark, Harrison, N.J.
82389	Switchcraft, Inc.: Chicago, Ill.
82647	Metals & Controls Inc. Spencer Products: Attleboro, Mass.
82768	Phillips-Advance Control Co.: Joliet, Ill.
82866	Research Products Corp.: Madison, Wis.
82877	Rotron Mfg. Co., Inc.: Woodstock, N.Y.
82893	Vector Electronic Co.: Glendale, Calif.
83014	Hartwell Corp.: Los Angeles, Calif.
83058	Carr Fastener Co.: Cambridge, Mass.
83086	New Hampshire Ball Bearing, Inc.: Peterborough, N.H.
83125	General Instrument Corp., Capacitor Div.: Darlington, S.C.
83148	ITT Wire and Cable Div.: Los Angeles, Calif.
83186	Victory Eng. Corp.: Springfield, N.J.
83298	Bendix Corp., Red Bank Div.: Red Bank, N.J.
83315	Hubbell Corp.: Mundelein, Ill.
83324	Rosan Inc.: Newport Beach, Calif.
83330	Smith, Herman H., Inc.: Brooklyn, N.Y.
83332	Tech Labs: Palisade's Park, N.J.
83385	Central Screw Co.: Chicago, Ill.
83501	Gavitt Wire and Cable Co. Div. of Amerace Corp.: Brookfield, Mass.
83594	Burroughs Corp. Electronic Tube Div.: Plainfield, N.J.
83740	Union Carbide Corp. Consumer Prod. Div.: New York, N.Y.
83777	Model Eng. and Mfg., Inc.: Huntington, Ind.
83821	Loyd Scruggs Co.: Festus, Mo.
83942	Aeronautical Inst. & Radio Co.: Lodi, N.J.
84171	Arco Electronics Inc.: Great Neck, N.Y.
84396	A. J. Glesener Co., Inc.: San Francisco, Calif.
84411	TRW Capacitor Div.: Ogallala, Neb.
84970	Sarkes Tarzian, Inc.: Bloomington, Ind.
85454	Boonton Molding Company: Boonton, N.J.

LIST OF MANUFACTURERS (Continued)

Code No.	Manufacturer/Address
85471	A. B. Boyd Co.: San Francisco, Calif.
85474	R. M. Bracamonte & Co.: San Francisco, Calif.
85660	Koiled Kords, Inc. : Hamden, Conn
85911	Seamless Rubber Co.: Chicago, Ill.
86174	Fafnir Bearing Co.: Los Angeles, Calif.
86197	Cilfton Precision Products Co., Inc.: Clifton Heights, Pa.
86579	Precision Rubber Products Corp.: Dayton, Ohio
86684	Radio Corp. of America, Electronic Comp. & Devices Div.: Harrison, N.J.
86928	Seastrom Mfg. Co.: Glendale, Calif.
87034	Marco Industries: Anaheim, Calif.
87216	Philco Corporation (Lansdale Division): Lansdale, Pa.
87473	Western Fibrous Glass Products Co.: San Francisco, Calif.
87664	Van Waters & Rogers Inc.: San Francisco, Calif.
87930	Tower Mfg. Corp.: Providence, R.I.
88140	Cutler-Hammer, Inc.: Lincoln, Ill.
88220	Gould-National Batteries, Inc.: St. Paul, Minn.
88698	General Mills, Inc.: Buffalo, N.Y.
89231	Graybar Electric Co.: Oakland, Calif.
89473	G. E. Distributing Corp.: Schenectady, N.Y.
89665	United Transformer Co.: Chicago, Ill.
90030	United Shoe Machinery Corp.: Beverly, Mass.
90179	U.S. Rubber Co., Consumer Ind. & Plastics Prod. Div.: Passaic, N.J.
90970	Bearing Engineering Co.: San Francisco, Calif.
91146	ITT Cannon Elect., Inc., Salen Div.: Salem, Mass.
91260	Connor Spring Mfg. Co.: San Francisco, Calif.
91345	Miller Dial & Nameplate Co.: El Monte, Calif.
91418	Radio Materials Co.: Chicago, Ill.
91506	Augat Inc.: Attleboro, Mass.
91637	Dale Electronics, Inc.: Columbua, Nebr.
91662	Elco Corp.: Willow Grove, Pa.
91737	Gremar Mfg. Co., Inc.: Wakefield, Mass.
91827	K. F. Development Co.: Redwood City, Calif.
91886	Malco Mfg. Co., Inc.: Chicago, Ill.
91929	Honeywell Inc., Micro Switch Div.: Freeport, Ill.
91961	Nahm-Bros. Spring Co.: Oakland, Calif.
92180	Tru-Connector Corp.: Peabody, Mass.
92367	Elgeet Optical Co. Inc.: Rochester, N.Y.
92607	Tensolite Insulated Wire Co., Inc.: Tarrytown, N.Y.
92702	IMC Magnetics Corp.: Wesbury Long Island, N.Y.
92966	Hudson Lamp Co.: Kearney, N.J.
93332	Sylvania Electric Prod. Inc. Semiconductor Div.: Woburn, Mass.
93369	Robbins & Myers Inc.: Palisades Park, N.J.
93410	Stemco Controls, Div. of Essex Wire Corp.: Mansfield, Ohio
93459	Weinschel Engr. Co., Inc.: Gaithersburg, Md.
93632	Waters Mfg. Co.: Culver City, Calif.
93929	G. V. Controls: Livingston, N.J.
94137	General Cable Corp.: Bayonne, N.J.
94142	Phelps Dodge: Yonkers, N.Y.
94144	Raytheon Co., Comp. Div., Ind. Comp. Operations: Quincy, Mass.
94148	Scientific Electronics Products, Inc.: Loveland, Colo.
94145	Wagner Elect. Corp., Tung-Sol Div.: Newark, N.J.
94197	Curtiss-Wright Corp. Electronics Div.: East Paterson, N.J.
94222	South Chester Corp.: Chester, Pa.
94330	Wire Cloth Products, Inc.: Bellwood, Ill.
94375	Automatic Metal Products Co.: Brooklyn, N.Y.
94682	Worcester Pressed Aluminum Corp.: Worcester, Mass.
94696	Magnecraft Electric Co.: Chicago, Ill.
95023	George A. Philbrick Researchers, Inc.: Boston, Mass.
95236	Allies Products Corp.: Dania, Fla.
95238	Continental Connector Corp.: Woodside, N.Y.
95263	Leecraft Mfg. Co., Inc.: Long Island, N.Y.
95265	National Coil Co.: Sheridan, Wyo.
95275	Vitramon, Inc.: Bridgeport, Conn.
95348	Gordos Corp.: Bloomfield, N.J.
95354	Methode Mfg. Co.: Rolling Meadows, Ill.
95566	Arnold Engineering Co.: Marengo, Ill.
95712	Dage Electric Co., Inc.: Franklin Ind.
95984	Siemon Mfg. Co.: Wayne, Ill.
95987	Weckesser Co.: Chicago, Ill.
96067	Microwave Assoc., West Inc.: Sunnyvale, Calif.
96095	Hi-Q Div. of Aerovox Corp.: Olean, N.Y.
96156	Thordarson-Meissner Inc.: Mt. Carmel, Ill.
96296	Solar Manufacturing Co.: Los Angeles, Calif.
96306	Microswitch, Div. of Minn.—Honeywell: Freeport, Ill.
96330	Carlton Screw Co.: Chicago, Ill.
96341	Microwave Associates, Inc.: Burlington, Mass.
96501	Excel Transformer Co.: Oakland, Calif.
96733	San Fernando Elect. Mfg. Co.: San Fernando, Calif.
96881	Thomson Ind. Inc.: Long Is., N.Y.
97464	Industrial Retaining Ring Co.: Irvington, N.J.
97539	Automatic & Precision Mfg.: Englewood, N.J.
97979	Reon Resistor Corp.: Yonkers, N.Y.
97983	Litton System Inc., Adler-Westrex Commun. Div.: New Rochelle, N.Y.
98144	R-Tronics, Inc.: Jamaica, N.Y.
98159	Rubber Teck, Inc.: Gardena, Calif.
98220	Hewlett-Packard Co., Moseley Div.: Pasadena, Calif.
98278	Microdot, Inc.: So. Pasadena, Calif.
98291	Sealectro Corp.: Mamaroneck, N.Y.
98376	Zero Mfg. Co.: Burbank, Calif.
98410	Etc. Inc.: Cleveland, Ohio
98731	General Mills Inc., Electronics Div. Minneapolis, Minn.
98734	Paeco Div. of Hewlett-Packard Co.: Palo Alto, Calif.
98821	North Hills Electronics, Inc.: Glen Cove, N.Y.
98978	International Electronic Research Corp.: Burbank, Calif.
99109	Columbia Technical Corp.: New York, N.Y.
99313	Varian Associates: Palo Alto, Calif.
99378	Atlee Corp.: Winchester, Mass.
99515	Marshall Ind., Capacitor Div.: Monrovia, Calif.
99707	Control Switch Division, Controls Co. of America: El Segundo, Calif.
99800	Delevan Electronics Corp.: East Aurora, N.Y.
99848	Wilco Corporation: Indianapolis, Ind.
99928	Branson Corp.: Whippany, N.J.
99934	Renbrandt, Inc.: Boston, Mass.
99942	Hoffman Electronics Corp. Semiconductor Div.: El Monte, Calif.
99957	Technology Instrument Corp. of Calif.: Newbury Park, Calif.

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94106